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Argentine Republic. Dirección general de
obras hidráulicas.

Proyect for improving the navigability
of the River Uruguay between the River
Plate and Concordia.

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PROYECT FOR IMPROVING

THE

NAVIGABILITY OF THE RIVER URUGUAY

BETWEEN THE RIVER PLATE AND CONCORDIA

EXPLANATORY INDEX

OF THE

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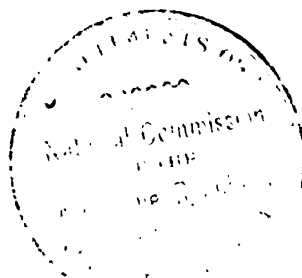


BUENOS AIRES

157056—IMPRESA, LITOGRAFÍA Y ENCUADERNACIÓN DE JACOBO PEUSER

Calle San Martín 200, esquina Cangallo

1904



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THE RIVER PLATE AND CONCORDIA



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157056 —IMPRESA, LITOGRAFÍA Y ENCUADERNACIÓN DE JACOBO PEUSER

Calle San Martín esquina Cangallo

1904

**Project for improving the navigability of the
River Uruguay
between the River Plate and Concordia**

GENERAL REGIME OF THE RIVER

As this Commission has finished the survey of the River Uruguay between Concordia and Concepción del Uruguay and has further made a recognizance of the same between the latter town and its mouth, and though the studies of its regime only exist in outline, as the principal part of it, viz:— the precise levelling — by which the numerous observations of velocities of the current, as well as the relative propagation of the floods and tides can be coordinated with accuracy — has not yet been carried out, the Commission is however in a position to present to the Superiority the results of the works carried out up to the present moment, which prove the practicability of the project of H. E. the Minister as described in the Memory presented to the H. Congress in 1899.

**PRACTICABILITY
OF THE PROJECT
OF H. E. THE
MINISTER.**

The observations made at the different gauges, which this Commission has placed in the River Uruguay, not only have corroborated the vague opinion which existed that some tides were felt in the Port of Concepción del Uruguay, but have closely shown the importance of the propagation of the tidal wave; not only as to the regularity with which they occur, but also as to their amplitude.

**APPROXIMATE
LEVELLING WITH
TIDE OBSERVA-
TIONS**

This circumstance — a direct levelling not existing — has made it possible to utilise the tidal observations

taken during a month in a period of low waters, which was noteworthy for its duration—from the end of December 1900 to the end of May, of the present year—to determine approximately the general slope of the river.

To arrive at this result, the observations of February of this year have been selected because the river during this month did not undergo variations of importance in its discharge, the changes in height at the gauges between Nueva Palmira and the Estancia Humaitá being solely caused by the propagation of the tides.

Supposing the geometric place of the high tides to be a horizontal line, which may be admitted in the case of a river having a small slope, the average of the maxima observed at the gauges has been taken as ordinates in a downward direction and joining up the ends of the ordinates obtained in this manner, the relation of the zeros (planes of reference) at the different gauges has been found, which has allowed to refer them to that of Nueva Palmira (which is 0.28 mts. below the zero plane of reference of the Riachuelo).

The result of this operation is that the zero of the gauge of the Island of Sauzal, Banco Grande and Uruguay appear to be 40,53 and 54 centimetres respectively above that of the gauge of Nueva Palmira (Sheet N°. IV).

The average minimum for each gauge has also been taken and by locating the resulting heights with regard to the zeros of the gauges, the geometric place of the low tides corresponding with the observed oscillations has been established, which mean amplitude in this manner has been determined for each gauge.

By establishing the relation of the zero (plane of reference) at the different gauges erected as far as the Estancia Humaitá (in front of Guaviyú R. O.) as well as by a direct levelling over a distance of 14.350 mts. between the estancia Humaitá and Nueva Escocia, and by calculating the slope of the river supposing the existence of a mean velocity of 0.15 mts. between the latter place and the foot of the Corralito Bar and by another levelling of this Bar where there exists a difference in level of 0.40 mts., the general slope of the river Uruguay between Concordia and

Longitudinal
section.

Palmira has been approximately determined and also by doing so it has been possible to draw its longitudinal section.

When the longitudinal section of this part of the river and the instantaneous sections of the maxima of the ordinary and extraordinary tides in every station has been drawn, the propagation of the tidal wave appears very distinctly.

INSTANTANEOUS
SECTION OF THE
PROPAGATION
OF THE TIDES.

From the examination of this drawing results that at Nueva Palmira the first high tide is the strongest, the difference between both becoming less as they propagate in the river Uruguay, but it also happens that they are reduced into a single one, or that they are no longer felt on account of the influence of the winds.

It may also be observed that during the ordinary tides the quantity of water discharged during ebb is greater than that entering during flood, the contrary happening during the extraordinary tides, when the river goes back to its ordinary level after 3 or 5 days, as may be observed in the curves representing the heights of the water, a circumstance which greatly favours navigation of the river Uruguay during the periods when the river is low.

Observing those same curves, it may be seen that the ordinary tides without wind and only caused by the lunar attraction disappear near Nueva Palmira (6 or 10 centimetres of height) meanwhile the extraordinary tides under the influence of the winds of the 2nd. and 3rd. quadrant arrive easily at Concordia and may reach at this port a height of more than one metre.

Slopes.

The slopes corresponding to the different heights observed in the various sections of the river Uruguay, have also been determined (Sheet III and IV) and the mean slope during ordinary high river results to be 0.06 mts. per kilometer between Concordia and Nueva Escocia and 0.015 mts. between Banco Grande and Fray Bentos.

Table of the high tides in the different ports, average height of the wave and its velocity of translation

PORT AND PLACES	TIME OF TIDES AFTER THE MOON HAS PAST THE MERIDIAN		MEAN DIFFERENCE OF TIME	DISTANCES	VELOCITY OF TRANSLA- TION	AVERAGE AMPLITUDE OF THE WAVE	Observations
	1 st.	2 d.					
	H.	H.	H.	Kil.	M/S		
Buenos Aires.....	6.20	19	—	—	—	—	
Nueva Palmira...	9.57	22.13	3.25	—	—	—	
Sauzal Island (PB)	15.25	3.05	5.10	101	5.43	0.64	
Uruguay.....	19.40	7.20	4.15	83	5.43	—	The distance between the Sauzal Island and Uruguay is approximate
Colón.....	22.55	10.35	3.15	33.40	2.86	0.48	
Nueva Escocia...	—	—	7.30	75.70	2.80	0.45	
			—	—	—	0.21	

Length of river in which the ordinary tide is felt 293.10

CURVES OF THE
HEIGHT OF WATER
AT THE DIFFE-
RENT PORTS.

The curves of the height of the water at all the gauges, placed since the creation of this Commission, has been drawn, and also those at other gauges of which existed records from years before, as at Fray Bentos, Concepción del Uruguay and Libres. The diagram of the principal gauges are shown (Sheets V, VI, VII, VIII & X).

Studying the curves of the heights of the water it is very easy to account for the actual conditions of access to the different ports and also for the continuous variations of level which the river undergoes owing to the tides during the periods when the river is low. It can also be observed that the small rises, which in this case take place above Concordia, are not sufficient to raise the level of the river below the Port of Concepción.

It may also be noted that, though the greatest rises observed in the River Uruguay generally coincide with a period when the Paraná is low and vice versa, the fall of the water in the first named river is more considerable when the above mentioned relation does not exist, which is only a consequence of the small slope of the River Uruguay.

The hydrometric observations are completed by diagrams of the meteorologic observations carried out at the Port of Concepción del Uruguay (Sheets XI and XII). With their aid it can be seen that the direction of the reigning winds and the general orientation of the river are the same. Their intensity, frequency and duration are indicated in sheet XII.

METEOROLOGIC
OBSERVATIONS.

The approximate velocity of the propagation of the rises of the river between the principal stations considered results to be: — between Paso de los Libres and Concordia two days, between Concordia and Concepción del Uruguay one day.

VELOCITY OF THE
PROPAGATION OF
THE RISES OF THE
LEVEL OF THE
RIVER.

The hydrometric observations have also been utilised to plot the corresponding heights of water for the Stations Concordia and Concepción del Uruguay (Sheet N° XIII).

For the determination of the velocities of the current, sections of velocity have been taken at the hydrometric stations Nueva Escocia and Concepción del Uruguay as well as at the different bars of the river (Sheets XIV & XV).

VELOCITIES OF
THE CURRENT.

The section at those two ports have allowed to plot the curves of the discharges and of the mean and maximum velocities in function of the heights observed for the Middle and Lower Uruguay (Sheet XIII). These studies have been carried out by the aid of a current meter system Woltmann with electric contact.

Curves of Discharge.

In consequence of the quickness with which these observations must be made in the River Uruguay, as great variation of level may occur within 24 hours during the periods of sudden rise of the river, they only consist in seven or eight verticals in which at each meter of depth velocities have been taken during intervals of two or three minutes.

METHOD USED FOR
THE OBSERVATION
OF VELOCITY.

The nature of the territory through which the River Uruguay flows is fairly consistent and the great proportion of mud which takes part in the formation of the islands and submergible grounds of the banks, makes them well able to resist the action of the current and explicates the relative stability of the different channels of the river.

The river bed of the River Uruguay is generally sand but in the lower Uruguay between the mouth of the Río

Mud.

Negro and Fray Bentos mud is found over a great extension especially in the shallow parts which the navigators characteristically call «El Barrial». The bed of the creeks and smaller channels as far as Concepción del Uruguay is also mud.

Gravel.

In the bar «Altos y Bajos» the suction dredger showed the existence of gravel at a depth of six meters under the zero of the gauge and the columns of the jetty of Concepción are placed in the same material which is situated under a layer of sand about 2 meters thick.

Going up stream the gravel appears more frequently and forms between Nueva Escocia and Concordia nearly exclusively the river bed.

It may be stated that, except in the stone bars of «Corralito and Hervidero», the Middle Uruguay does not bring down gravel during the great flows of water and that the gravel which is found in the river bed is not brought down from great distances but from both banks where layers of this matter are found at the surface of the ground or under a thin layer (cap) of humus.

The shallow parts formed by gravel of a diameter from 3 to 5 centimeters are specially found in the part of the river where the underground on account of its hardness has not been excavated and acts as a weir. This gravel forms a conglomerate where great velocities of current are observed.

EASY EXTRACTION
OF SAND BY THE
AID OF SUCTION
DREDGERS.

Where the conglomeration does not exist, the sand, the weight of which is about 1500 kg. per cub. met., is easily raised by the suction dredger N° 11 C, whose speed of water in the suction pipe is only 3,50 meters per second. The specific weight of the sand causes it to deposit quickly in the hold of the barge and only a very small quantity flows over board back to the river.

Downs.

At certain places the sand forms downs, as for instance on the Oriental coast at Nueva Palmira on the North and South side of the Arroyo Negro and on the Argentina Coast north of the jetty of Concepción del Uruguay, on the island «Marineros» opposite Paysandú and at the «canchas» of Pepeají and San José.

The sand banks in the river contain a great amount of quartz which does not allow any vegetation, they are easily

shifted by the winds and their height does not exceed 1,80 mts. above low river.

The stones or rocks, found in the river Uruguay may be divided into two classes:

Rocks.

1st those which originally formed part of the superior layer of the ground and through its socavation when the river bed was formed sunk down to the place which they actually occupy; 2nd those which belong to the inferior layers and form compact banks.

The first are sandy and have more or less the hardness of grindstones, for the reasons given before they are loose stone and form heaps that can be extracted very easily.

The second are equally sandstone and those of the «Coralito» bar seem to have been formed by a conglomerate of limestone the softest parts of which has been destroyed, the harder remaining and these once being silicified, besides getting firmer, have adopted irregular shapes. For this reason they are so dangerous to the hulls of the vessels.

There are also heaps of stones below the port of Paysandú and at the mouth of the Arroyo Sacra on the Oriental coast, and on the Argentina coast below the Arroyo Urquiza. Those stone heaps form the breakers of Paysandú, of the «San Francisco» bar, of the limekiln Colombo, of Pepeají, and of the arroyo Spina or «del Griego».

The sandstone in beds has been found by borings at Chapicuy and in the Port of Concordia.

The stones of the Hervidero and Salto Chico are in some parts loose and in others they form beds; their texture shows rather a plutonic than a sedimentary origin. They are very hard in comparison with those named before.

ACTUAL NAVIGATION

The actual navigation of the River Uruguay consists of: the ocean navigation which goes to below the San Francisco bar and the coastwise navigation which reaches to Concordia (Salto more correct).

The ocean navigation is actually done by vessels from Ocean navigation.

700 to 1000 tons of effective load, and of a draught of 18 ft. as maximum.

A serious inconvenience for vessels above certain draught is the «Barrial» bar situated below Fray Bentos, where the mean draught is only 17 feet, though vessels can cut their way through this bar drawing two feet more. (see page 16).

Before de dredging of the «Banco Grande» and «Altos y Bajos» bars was carried out, the captains of the vessels stipulated in the shipping contracts that the vessels should be lightened or their cargo be completed below the first mentioned bar. To-day this inconvenience has disappeared.

THE COASTWISE
NAVIGATION.

The coastwise navigation is carried out: 1st. by river steamers, which belonged successively to the following Companies: «Salteña», «La Platense», «Nacional de Navegación á Vapor», and «Mensagerías Fluviales del Plata» and which are now all belonging to Mr. Nicolás Mihanovich; 2nd. with lighters specially constructed or made up from old steamers, out of service, and which are towed, and 3rd. with the smaller coastwise vessels. Nearly all the river steamers ran before in the River Uruguay, the navigation of which used to be fairly active on account of the numerous slaughterhouses situated on both banks and also for the reason that there existed no other economical communication with the ports of Buenos Aires and Montevideo.

RIVER STEAMERS.

At present and in consequence of the paralisation of the slaughterhouses and the construction of railways in the Oriental Republic, which unite its Capital with Paysandú, Salto and the Brazilian frontier, this activity has partly decreased but is still sufficiently important to occupy for the service of the river the steamers, Paris, Triton, Helios, Labrador, Comercio, Tridente and others, which make weekly trips.

The draught of the steamers with a normal cargo on board is 9 feet, in which condition they can carry 300 passengers and 550 tons of merchandise.

Several ports of the River Uruguay are situated on creeks and the cargo for them is transhipped from the large steamers into smaller ones, which have sufficient accommodation for passengers and cargo.

In the zone between Colón and Concordia the transshipping is done directly in the ports by means of boats and lighters.

The navigation as carried out by towed lighters is the most economical because, owing to their capacity from 300 to 600 tons, they are only manned by a crew of 4 men and a skipper. They are used for the transportation of grain and the produce of the slaughterhouses and generally do not go beyond Colón as those of special construction have a draught of 9 feet, whilst the others go as deep as 15 feet.

The third group, formed by the smaller coasting vessels, deserves more protection from the Public Authorities so as to make it possible for them to compete with the steamers and lighters, the actual competition being very unequal. The number of vessel of this class, which play on the River Uruguay and frequent the Argentine ports are more or less close on 300, they carry a load from 30 to 100 tons and draw from 5 to 8 feet.

THE COASTWISE
NAVIGATION WITH
SMALLER VESSELS.

The draught of all the coastwise sailing vessels that entered the Port of Concordia having been taken, their average draught resulted to be from 8 to 10 quarts (from 1.73 to 2.16 mts.)

In order that the river steamers may go up river to Concordia it is necessary that the height of the water at the gauge of said port be 2,50 meters.

During the years 1898-1900 and the first half of the year 1901, the number of days during which the steamers had to tranship into the smaller ones at Paysandú have been 76-48-149 and 142 respectively.

In order that the coastwise vessels with a draught of 8 quarts (1.73 meters), which are the more numerous, may pass the bar of «Chapicuy», it is necessary that the gauge at «Nueva Escocia» marks 0,86 meters of water.

INCONVENIENCES
AND PARALIZA-
TION SUFFERED BY
NAVIGATION.

This navigation was paralyzed during 29 days during the year 1900 and 63 days during the first half of the year 1901; during the last period there was during 23 consecutive days less depth than is necessary for the draught mentioned.

There were even days during which navigation at the bar of Chapicuy was completely stopped and passengers had to continue their voyage in boats.

COINCIDENCE OF
THE TIME DURING
WHICH THE RIVER
IS LOW WITH
THAT OF THE EX-
PORTATION OF
THE HARVEST.

IMPORTANCE OF
TRAFFIC IN THE
ARGENTINE
PORTS.

RESUME.

As can be seen from the diagrams of the height of the water, the periods of the lowest rivers occur precisely at the time of the exportation of the harvest. The losses suffered by commerce and navigation, specially by the coastwise, are in some cases enormous.

The amount of the yearly traffic of the argentine ports on the river Uruguay is estimated to be 350.000 tons and this amount would increase if the condition of navigation were improved, for many of the cargoes, which before went to Concordia in transit with destination to Brazil and which are now sent directly by rail from Montevideo or Paysandú to the mentioned Republic (which will occur on a yet larger scale once the port of Montevideo is finished) would in such case again take the highway of the river.

Condensing the preceeding antecedents it will be seen that the slope of the river is insensible as the high tides are propagated as far as the port of Concordia, which, without this circumstance would not be accessible during about four months of the year but for vessels drawing one metre.

For the same reason the fear disappears which might exist respecting the possibility that the level of the retained water upstream of the different bars will be lowered to a sensible degree after their canalization.

The only great slope is that of the Corralito bar, but as we will see further on, when this bar will be considered in detail, the work to be carried out is specially one of rectification, the increase of section which will be given to the river at this place being depreciable.

On the other hand, the fact that the retained water above this bar might lower a few centimetres, will do no injury to the Port of Concordia, where there are no works and in front of which there is a depth which is at some places as much as 25 meters.

Entering now into the description of each section of the river Uruguay, the difficulties it presents to navigation, and the manner in which they may be remedied, will be studied.

ZONES OF THE RIVER URUGUAY

The river Uruguay has been divided into the following zones, or sections, which correspond to differences of the regime and distinct conditions of navigability.

1st, lower Uruguay: from its mouth in the River Plate situated above Nueva Palmira between Carbon Point and Chaparro Point, to Concepción del Uruguay. Its extension is about 180 kilometers (Sheets 5, 6, and 7).

2nd middle Uruguay: From Concepción del Uruguay to Salto Chico, situated immediately above Concordia, its extension is about 160 kilometers (Sheets 2, 3 and 4).

3rd upper Uruguay: From Salto Chico up river. Its extension is 425 kilometers (Sheet 1).

LOWER URUGUAY

The Lower Uruguay has again been subdivided into two parts, which differ greatly between each other: the first goes from its mouth to the mouth of the river Gualaguaychú, and the second from the mouth of the river Gualaguaychú to Concepción del Uruguay.

The first section embraces an extension of 93 kilometers with a width from 8 to 10 kilometers forming a great lake crossed by a relatively deep channel, but which width is reduced in comparison with the width of river.

This circumstance and the curves of the channel and its banks which are often very steep explain, the great difficulties which this part of the river presents to its navigation with ocean-as well as with coastwise vessels.

The ocean vessels never navigate this part of the river during night time, the river steamers however have to do so in order to pass during the day the bad bars formed

1st. SECTION.

From the mouth of the river Uruguay to the mouth of the Gualaguaychú.

Difficulties for the navigation.

Manner in which the river is navigated.

324848

of stone of the Middle Uruguay, also some coastwise vessels do the same if they have skippers on board who know this part of the river well. This navigation is done by taking directions which are from time to time controlled by the sounding lead.

Buoys.

Some buoys, marked on the English map, and which have been placed by the Oriental Government, exist, but they disappear frequently, because the side wheels of the river steamers often destroy them.

As far as the depths, indicated by the mentioned map, are concerned, they are accurate and so are the directions of the channel; the only observation to be made being, that the soundings given are referred to the level of the ordinary water, mean while this Commission has adopted as plan of comparison, the level of the lowest low tide, which has been established from observations made during a period of 1866 days at the mole of Fray Bentos and from several references at Palmira.

The lowest tide observed at a gauge which has been placed in a arbitrary manner at the mole of Liebig's Extract of Meat Factory, at Fray Bentos was 2.90 meters on the 24 th. of July 1896 at 7 h. p. m. Adding 10 centimeters to this level, in order to deduct three meters in whole figures from all observations, the readings with reference to the zero adopted by the Commission has been obtained. From the curves of the heights of water (Sheet VI) results that the plan of reference adopted remains about 0.30 meters below the mean of the extraordinary low tides observed.

In consequence there will always be more depth disposable for navigation than that indicated by the soundings on sheets N°. VI and VII.

As may be seen from the table, the tide propagates in this entire zone with the same intensity as in the River Plata which causes that at least 2 or 3 times each week the water rises to a level of about three or four feet above its ordinary level at low tides, increasing the depth indicated by the plans equally.

Floods and high tides.

The great rises of the River Uruguay are at Palmira not so much noted as the highest tides of the River Plate, both

may reach a height of about three or four meters as an average.

At Fray Bentos these differences of level are more or less the same, being 3,62 meters for the greatest rises of the river and 2,30 meters for the highest tides.

Up to the present time no special studies of the velocities of the ocurrent have been made in this part of the river, but it has been observed that, in consequence of the influence of the tides, its velocity is sometimes zero and even in a direction up river, when the river is low.

Velocity of the current.

After having passed Carbon-and Chaparro points, going up river, the navigable channel is deep, wide, nearly straight and very close to the Oriental Coast, which circumstance makes its navigation easy till Arenal Grande, where there is a wooden mole, is reached.

From carbon point to Arenal Grande.

From here the channel curves towards the Argentine Coast, till after having arrived more or less in the center of the river it returns with a sudden bend towards the Oriental Coast in the direction of the point called «Cabeza de Negro». In the latter part of the channel, named the «Canal de Márquez» there is only a depth of 20 feet meanwhile before arriving at it there are depths of 50 feet and more.

Canal de Márquez

Navigation in front of this point is easy, but soon the channel begins to change its direction and to become narrower, forming what is called the «Amarillo» bar which has only a depth of 18 feet by a width of about 250 meters, the river itself at this place being about 12.000 meters wide. After having again changed direction the «Tarantanas» channel, the sides of which are very steep and where there is a depth from 36 to 52 feet, is reached.

Amarillo Pass.

Tarantanas channel.

In front of the Delta of the River Negro the channel goes nearer to the Oriental Coast and though forming a curve, this circumstance and the fact that it is broader at this part with depths varying from 28 to 40 feet, makes its navigation easy.

Above the Northern mouth of the River Negro, North of the island Yuqueri the channel divides itself into two others named the English and the Caracoles channels.

English channel and Caracoles channel.

The first is navigated by vessels of great draught and by the river steamers. At its beginning it is narrow, 250 me-

ters, but afterwards it becomes wider and disappears in the bay into which the river Gualeguaychú flows. Its depths varies from 20 to 44 feet. The Caracoles channel being of easy navigation for being near to shore is utilised by coast-wise vessels of small draught. The depth may be about 6 feet in its northern mouth but its location has not been indicated on the plans as it could not be explored, the steamer of which the Commission disposed, drawing too much water. It may be observed that when going up river that meanwhile the Argentine coast is low and formed by mud, which is sometimes liquid the Oriental coast is exclusively sand or tosca.

«Barrial» bar.

In front of Gualeguaychú exists on the Oriental side a deep channel which is separated from the English channel by a shallow part which has been characteristically called the «Barrial», with a depth of only 12 feet at the adopted zero of this point.

The shallow place is indicated on the English Chart with 17 feet depth which may be found in this pass in consequence of the tides and the facility with which it may be ploughed by the keels of the vessels to a depth of 2 feet.

This pass has not been surveyed; before the bar of «Banco Grande» had been dredged it was not considered to be an obstacle to navigation, which appears from the fact that the ocean vessels were chartered with a full cargo to below the last named bar. Neither is it mentioned in the nautical instructions of the River Plate of the hidrografic service of the French Navy. Till some 7 years ago the exportation consisted mainly in products of the slaughterhouses and the importation of salt for the same establishments which was done with sailing vessels from 14 to 18 feet draught, but since, notwithstanding the bad harvests of those very years, the direct exportation of wheat and corn started in the Port of Concepción del Uruguay and as the tendency is to use vessels of the largest tonnage possible in this trade, the «Barrial» pass becomes a serious obstacle, though its importance lessened by the nature of the bottom and the frequency of the tides. Vessels with a draught of 18 feet may pass this bar in the proportion

as indicated in the graphic table shown in the respective drawing (Sheet 6). The quantity to be dredged for a depth of 17 feet at the adopted zero by a width of 200 meters is about 180.000 cubic meters.

As there exist immediately below the pass a channel of a depth from 30 to 50 feet, it is probable that in order to carry this work out, the suction dredger « 11 C. » may be employed, and that by making use of the periods of floods, the lifted material after having been put in suspension will be carried away by the current.

In case this proves to be possible, the excavation might be carried out, working night and day, in a short time.

It is intended to proceed within an early date with the survey of this pass and to make a trial with the named dredger, which trial will be the base of a plan which in due time will be submitted to the Superiority.

Once this bad bar has been overcome, navigation has no difficulties till past the port of Fray Bentos, the channel being wide and deep almost following the oriental coast.

From the foregoing results not only that in the zone which has just been described, the bar called "Barrial" with reference to the depth to be given to the Uruguay Inferior is the only bad one existing, but also that the difficulties with respect to the course to be followed by navigation, even during day time, in consequence of the sinuities of the channel and because there are no land marks, are many.

The most appropriate means to facilitate navigation and to give confidence to the pilots who enter the river Uruguay with vessels of great draught is to mark the channel over its whole extension with luminous buoys.

They ought to be luminous, in order that the vessels or river steamers don't sink or injure them by colliding with them during their voyages which in this section of the river are always during night time and which would be difficult to be avoided considering the manner this zone is navigated during night time using the lead and taking courses, going near the slopes of the channel from one side to the other, which sides are the very places where the buoys must be located.

Necessity of
buoying with lu-
minous buoys.

According to the plan of this zone of the river, which has been specially prepared to project the buoying, 25 luminous would be sufficient to mark the navigable channel from the mouth of the river Uruguay to Fray Bentos.

Generally the sites indicated for the buoys are the prominent points of the channel and the places where the banks are the steepest, placing two buoys where the channel is narrow and dangerous. At the beginning and at the end of the projected channel in the «Barrial» pass two buoys will be provided. It will be noticed, that according to this project, there will be when going up river 11 buoys carrying white or green lights on the portside of the channel, 14 carrying red lights on the starboard side.

In concluding it must be acknowledged that for the exactness of the soundings shown on the plan, the observations made since the year 1896 at the gauge of the mole of the «Extract of Meat Factory» at Fray Bentos, have been of the greatest utility and that they were most kindly supplied to this Commission by the Manager of said Factory.

The Gualeguaychú
river.

The first Argentine port when going up river is that of Gualeguaychú; it is situated some 20 kilometers from the mouth of the river of the same name and some 33 kilometers from the bay of Fray Bentos (Sheet 6).

This river has a mean width of 100 meters by a mean depth of 8 feet. It has only one notable curve, but as its radius is 300 meters, it is of no considerable inconvenience to the actual navigation.

The difficulty which vessels of a regular draught meet consist in two shallow bars of stone; one of them is near the mouth of the river, the other in the neighbourhood of the port. The first one has an extension of 200 meters and is covered by only three feet of water when the river is very low.

Besides those bars there are isolated rocks which are unperfectly known spread over the whole length of the river and which are dangerous to navigation.

To the difficulties of the mentioned river is to be added the extensive bar existing at its mouth, which, formed by mud, makes navigation impossible when the river is low,

by closing the entrance of the river completely for vessels of more than 3 feet of draught. This circumstance however helps to decrease the dangers arising from the existing shallow places in the river where there is stone.

This second part embraces an extension of 87 kilometers, which differs greatly from that described before. Immediately above the mouth of the River Guauguaychú begins the formation of islands which increases when going up river and which islands separated by several arms or creeks form in the neighbourhood of «Las Tres Bocas» (the three mouths) a delta with a width of 12 kilometers which is completely flooded when the river is high.

This circumstance renders navigation in this part easy for the pilots, in consequence of the many landmarks which the banks offer to them.

Already in this section the great difference in level is observed during great flows of water. The greatest slope observed is 0,0467 meters per kilometer, the mean slope when the river is high is 0,0195 between Fray Bentos and «Banco Grande» and 0,035 meters between the latter locality and Concepción del Uruguay (Sheet III).

The mean velocity observed in the bar of «Banco Grande» was 0,714 meters and the greatest was 1,16 meters when the level of the river was 2,70 meters.

In this latter part with the greater slope, are the different sand bars situated, which are an obstacle to navigation with vessels of great draught.

The influence of the tides is felt in the port of Concepción del Uruguay to a height of 2 meters at the gauge, their mean height, when the river is low, being 62 centimeters.

From Fray Bentos to the North point of the Zapatero Island there is only one channel for the navigation, and the difficulty in this part consists in avoiding the South part of the Abrigo Island in front of which the «Unzué» port (also called «Abrigo» or «Nandubayzal» port), is situated, which was examined by a commission of the Navy in the year 1882.

A little above the Zapatero Island navigation can select from two channels which are called the «Boca Chica» and the «Filomena» channel. The first named channel

2nd. SECTION.

From the mouth of the river Guauguaychú to Concepción del Uruguay.

owes its name to its narrowness between the « Boca Chica Island and the Southern extremity of the « San Lorenzo » Island.

Channel of the
Boca Chica.

This is specially used by the coastwise navigation, and also by the river steamers when the river is high. It is preferred by navigation notwithstanding the danger of collisions with river steamers, because it is more protected and shorter than the « Filomena » channel.

Its minimum depth is 9 feet, which is found a little above the Northern point of the island of the « Boca Chica ».

The Filomena
channel.

The « Filomena » channel owes its name to the vessel « Philomel », whose Commander B. J. Sullivan, of the British Navy recognised it for the first time in the years 1845 and 46.

It is the route followed by the vessels of great draught and by the river steamers when river is low. Its smallest depth of 19 feet is found at the entrance of its passage between the island of the « Burro » and of the « Filomena Grande ».

Both channels join to separate again a little further on, at the point called the « Tres Bocas ».

Channel of the
China.

The one nearest to the Argentine coast continues under the name of creek of the « China » and terminates in the interior port of Concepcion del Uruguay.

Bars of Tala and
of the Calderon
island.

There are two bars which difficult navigation of vessels of 9 feet draught in the channel of the « China », these are the bar of « Tala » and that of the « Calderon » island, the latter being situated in the very port of Concepcion del Uruguay. The bed is formed of mud and the depth at the first named bar is 5 and the second $3\frac{1}{2}$ feet at the zero of the gauges at those places.

As the river steamers and coastwise vessels could take this route when entering or leaving by the access channel to the interior port of Concepcion del Uruguay, discharging or taking their cargo there, it would be convenient to deepen the last named bars as well as the channel of the « China » (which actually has only a depth of 8 feet) to 9 feet, which besides other advantages, would benefit the port of Capalen, Campichuelo and Piedritas, which are utilised by colonies and important cattle ranches of the neighbourhood.

The other channel follows, from its separation above the Principal channel. « Tres Bocas » the Oriental coast and form the most important and deepest arm of this section of the river. It is used by the general navigation of the river.

It is connected to the « China » channel by various arms as those called the « Colon » the « Solitaria », « Campichuelo » and « Cambacúa ».

It was this part of the river which offered the greatest obstacles to the navigation of great draught, as there existed sand bars where the depth was reduced to only 13 feet.

At present part of these obstacles have been removed, only some of less importance remaining.

They are the following:

The bar of « Roman » with 16 feet of water at lowest river, is situated in front of the « Bonfiglio » island. The extension is only 400 meters and in order to remove it and to form a channel 17 feet deep by 200 meters wide a maximum quantity of only 15.000 meters cube has to be dredged. The « Roman » bar

The bar of « Banco Grande », where there was only a depth of 13 feet, has been dredged to 18 feet and is marked as well during day — as at night time by beacons placed in the line of the course to be followed. The Bar of Banco Grande.

The survey of the « Montaña » bar has already been carried out and a channel of 17 feet has been formed, but in consequence of its sinuosity there is practically only a depth of 16 feet. The Bar of Montaña.

In order to straighten the channel and to bring its depth to 17 feet over a width of 200 meters it will be necessary to dredge a cube of 90.000 M³.

By decree of the 16 th of August 1901 its rectification within a cube of 10.000 M³ has been provisionally authorized.

The channel has been marked at starboard side with three buoys numbered 2, 4 and 6.

The « Altos & Bajos » bar, which was a similar obstacle as the « Banco Grande » bar has been deepened and marked by beacons in the same manner. The « Altos & Bajos » bar.

Before arriving at this bar and at the mole of the port of Concepcion del Uruguay, there exist three places with a depth of only 17 feet.

**Works to be
carried out.**

The zone between Fray Bentos and Concepcion del Uruguay is, as we have seen, more easy to navigate than the one which has been considered first, as the proximity of the channel to the coast allows its direction to be followed, but on the other hand there exists several sand banks which must be dredged and buoyed.

Dredging.

The dredging has already partly been carried out and its conservation has given good results as well as the system of the beacons and buoys used.

Buoys and Beacons.

It is necessary to place buoys at the following places:— One at the South part of the «Abrigo» island in order to avoid the shallow part at the extremity of this island.

Three in the «Filomena» channel. The first one carrying the number 32 to mark the direction to be followed in the middle of the river, the second to mark the curve formed by the channel and the third one in the narrow and shallow mouth between the «Burro» and the «Filomena Grande» island.

Two in the «Roman» pass.

One in the bar of «Banco Grande» in order to complete the demarcation of the beacons, marking the Northern end of the channel, which is very narrow.

Four in the «Montaña» bar.

One below the «Altos y Bajos» bar to mark the slope of this bar; and finally one nearly in front of the mole of Concepción del Uruguay to mark the channel only 17 feet deep in the middle of the river.

The number of the buoys necessary to be placed amount therefore to eleven at starboard and two at port, making a total of 38 buoys between the River Plate and Concepción del Uruguay, which must be luminous for the same reasons as given with respect to those projected for the zone between the River Plate and Fray Bentos.

THE MIDDLE URUGUAY

The zone of the river, which has been called the Middle Uruguay begins at Concepción del Uruguay, this part being the terminal port for Ocean navigation and because a little higher up river at the Oriental Port of Paysandú the transshipments of the vessels begin, which continues till Concordia.

State of navigability.

At first, in consequence of the dredging in the shallow places of the «Almiron Grande» and «Almiron Chico» bar, carried out by the Oriental Government to a depth of 15 feet, it was projected to give the same depth to the San Francisco bar, which obstaculises the access to the Port of Colon, but afterwards as it appeared that those works of canalization had not given a satisfactory result for want of maintenance and buoys, this idea was given up, it being decided to provide only a depth of 2,74m (9 feet) for this bar, which decision was approved by Superior decree of the 15th. of June 1901.

Projected depth of the bars between Uruguay & Colon from 15 to 9 feet.

The projected depth for this entire zone has therefore been fixed at 2,74 meters (9 feet) by a width of 50 meters (the «San Francisco» bar excepted, which will have a width of 100 meters) which will be sufficient for the proposed purpose as a glance at the curves of the levels of the water at Concepción del Uruguay, Nueva Escocia and Concordia will show. It must here be observed that in all the plans and calculated quantities a depth of 3 meters has been adopted in order to keep into account the imperfect class of work done by the dredgers, so as to obtain practically depths of 9 feet.

Though the river Uruguay between the River Plate and Concepción del Uruguay has only been recognised, — only the principal bad bars having been surveyed — the part now under consideration has been completely surveyed in all its extension the corresponding plan having been drawn to a scale of 1:10.000 (Sheets A to N) and those of some bars at a scale of 1:2000 (Sheets A' and C').

Complete survey of the river between Concepción del Uruguay & Concordia.

The principal obstacles to navigation are several shallow places formed by sandbanks, gravel or stone, which du-

Difficulties for navigation.

ring the period of a low river cause great loss to navigation.

Slopes.

During the floods, the current is excessive, specially from Nueva Escocia to Concordia the mean slopes being 6 centimeters and the maxima being from 7 to 9 centimeters per kilometer.

Velocities of current.

The greatest velocities of the current observed at the ports of Concepción del Uruguay, Colon and Concordia were 1,45, 1,80 and 2,20 meters per second, corresponding respectively to riverheights of 5,49, 8,55 and 12,56 meters.

Tides.

The tides propagate with the same mean height to the Port of Colon as they do at Concepcion del Uruguay; the ordinary tides reach to the Chapicuy bar and extraordinary as far as the Port of Concordia.

Stretch of Concepción del Uruguay.

In front of Concepción del Uruguay the river has an ample channel with a minimum depth of 20 feet, which forms a splendid roadsstead 7 kilometers long by 700 meters wide, which extends as far as the extreme South of the «Almiron» island (Sheet *N*).

At this point the river divides itself into two principal arms. In the Eastern arm, at the foot of the bluffs, the channel maintains a great depth as far as the slaughterhouses «Casas Blancas» after which the depth decreases to 6 feet so that during a low river this arm is only navigable to the mentioned slaughterhouses (Sheet *M*).

The Western arm which is used by the general navigation, divides itself again into two arms, one near the Argentine coast and the other near the Oriental island («Almiron Chico») pass; both have a depth of 13 feet, but the latter one is generally preferred as its navigation is easier.

Both last named channels unite again into a single one, which is wide and deep till the bar of «Almiron Grande» has been reached.

This bar, where there was before only a depth of 8 feet at very low river, has, as has been stated before, been dredged to 15 feet. Of this has remained a depth of 10 feet, so that at present it is no longer an obstacle to the navigation of the great river steamers.

It is however not yet marked, which can be effeciently

done with 2 beacons placed in line on the Argentine coast and four buoys.

This bad bar of «Almiron Grande» having been passed and after the two arms of the «Almiron Island» have joined again, the channel becomes wide and deep, having a depth of 22 meters in the very port of Paysandú (Sheet *L*).

Stretch of Paysandú.

There are on the Oriental shore near the «Sacra» creek several shoales which remain above water when the river is low but which offer no danger to the navigators as they are outside the general course.

Stoney shoales, creek of the Arroyo Sacra.

Different is the shoal situated above the port of Paysandú and which is called the shoal of the «Curtiembre» (Tannery). On it grounded the river steamers «Helios» and «Paris». It can be avoided during day time, navigating a little westward of the line formed by the two towers of the Church of Paysandú. At present the shoal is marked by a buoy, which has been placed by this Commission.

Shoal of the «Curtiembre»

The channel widens again till it reaches the lower end of the «San Francisco» island in front of the creek on the Oriental shore of the same name.

Here again it presents two arms to the navigation (Sheet *K*). The Eastern arm was before the one followed by the sailors, till it was discovered, that in the Western there is 2 feet more of water so that at present the first named is only used by vessels of small draught, which go to load lime or limestone in the River Queguay. The channel at the North point of the «San Francisco» Island, which in days before formed the pass indicated by this name, is now no longer used.

The bar of San Francisco.

The Western channel has been surveyed in the years 1895 and 1901, no notable differences in its configuration has been found.

It has a depth of 6 feet and being curved caused the frequent groundings that have taken place at this point. Upstream of the bar proper exist some sand banks, which beginning at the South end of the Queguay island, cross the river in the direction toward the great bank at the North point of the Hornos island.

The bar forms a weir when the river is low and the water flows in this case round the Northern point of the island of

San Francisco, where it has excavated a channel of 50 meters wide by a mean depth of 3 meters. When the surface was levelled over the distance of 450 meters in which the current is observed, a difference in level of 57 millimeters was found. For this reason it may be hoped that once this bar has been canalized, the improvement will also be felt at the sand bank in consequence of the greater slope, which will be established in this part of the river.

Dredging work in execution.

The dredging of the «San Francisco» bar which has been authorized by decree of the 15th of June of this year (1901), is now in execution. The channel will be 100 meters wide by a depth of 9 feet at lowest river. Three buoys have been placed to mark the old channel, but when the dredging has been carried out, their number must be previously increased to eight and completed by beacons in line on the Argentine coast until luminous buoys are provided.

Shoal of the San Francisco island.

Near the Oriental coast of the San Francisco island exist a shoal which is visible when the river is very low, but which presents no danger to navigation as it is situated outside of the general route.

Stretch of «Colón» and shoal of the limekiln of «Colón».

With exception of a shoal situated on the Argentine coast below the lime factory «Colón», which must be indicated by a buoy, navigation hereafter meets with no difficulties until arriving in front of O'Connor's slaughterhouse.

Bar of Peruchoverne.

A little above the mole of the slaughterhouse begins the bad bar—formed by sand and gravel—of «Peruchoverne» where there is only 5 feet of water when the river is very low.

The work to be carried out here, consists in dredging 92.000 M³ in order to form a channel with a section of a width of 50 meters in the bottom by 9 feet depth when the water marks zero at the gauge. As has been stated already before, this is the projected cross section for the channels to be opened in the bad bars till arriving at Concordia (Sheet *J*).

The projected buoing consists in four buoys and a line of beacons on the Argentine coast.

Stretch of the «Boca Chica».

Once the mentioned bar has been passed, the navigation is easy, the depth being great till arriving at the Boca Chica

where over a considerable distance great sand banks are met with (Sheet *I*).

The deep channels terminates on the West side of the «Boca Chica» island and the navigator has to take the smaller arm, which follows the East coast, which is formed by bluffs.

The depth of this channel varies from 3 to 5 meters and the maximum width is some 50 meters, for which reason 3 buoys must be placed on the East bank.

Past the North point of the «Pepeaji» island there exists on the Oriental shore a shoal, which protrudes some 80 mts in the river, and which is indicated by a buoy, which has been placed by this Commission.

Shoal of «Pepeaji».

A little below the «Pepeaji» creek exists a shallow place of sand and gravel, which carries the same name and where the depth is only 5 feet at the zero of the gauge (Sheet *H*).

Bar of «Pepeaji».

In order to eliminate the obstacles which this part of the river presents, several directions have been indicated in the corresponding plan, but the direction corresponding to the smallest cube to be dredged and which maintenance will be the easiest, is, that actually followed by navigation, which also has the advantage that it can be marked by a line of beacons on both shores, and four buoys. The cube to be dredged in this bar is 100.000 M³.

Above the «Pepeaji» bar the channel occupies the whole width of the river and is of great depth till the «Cancha Seca» is reached which is a shallow placed formed by the sand, which during the great floods of water, is brought down from the sandy bottom of the Merlo creek and which is dropped again when the water of this creek loses its speed on entering the river (Sheet *G*).

«Cancha Seca»
bar.

There are two channels for navigation, one in the middle of the river and the other near the Argentine coast.

In the first channel there are 22.000 M³ to be dredged and it can be marked with two beacons in line on the Argentine shore and four buoys.

The second channel requires an excavation of only 9000 M³ of heavy gravel which is found above the arroyo «Palmar», but at this place, as well as above the «Spina» creek there are shoals near the shore, these protude about

80 meters into the river, and are only visible when the river is low.

As the channel near the Argentine shore is situated where the latter is of a concave form, it is to be supposed that its maintenance would be more easy than that of the other situated in the middle of the river, however vessels would not navigate it with the same confidence and it is for this reason that the dredging of the latter must be preferred.

Stretch of the lime
kiln of «Barquin».

Hereafter-following the foot of the bluffs called the lime kiln of «Barquin» — the river has a great depth, which continues till the sand banks, situated at the Southern part of the island «San José», are met with.

Bar of «San José».

The cube to be dredged here is about 50.000 M³ and after this has been done the channel ought to be marked by beacons in line placed on the Argentine shore and also by four buoys (Sheet *G*).

There exists also a channel along the Oriental shore, but as its deepening would require the excavation of a greater volume than in the case of that on the Argentine side of the river, it has been decided to deepen the latter.

Stretch of the curve
of «San José».

After this a wide channel of great depth is found, till the bar called the «Sombrerito» has been reached.

Bar of «Sombrerito»

There is little depth in this part of the river, and at present (1901), it is ten feet at lowest river. Contrary to the general rule, the channel in this case is found in the convex side of the curve, formed by the river, that means to say, very close to the Argentine coast (Sheet *F*).

This is the only place in the River Uruguay where changes in the riverbed have taken place, the channel running before more towards the East, according to statements of old pilots.

It will be necessary to rectify the channel here, which will require a dredging of about 6300 cub meters and to mark it with four buoys.

Stretch of «Guaviyú».

When this channel is passed, the direction towards a stoney point, which indicates the mouth of the creek, Guaviyú, is followed, leaving the «Sombrerito» island on starboardside.

Bar of «Guaviyú».

When passing the mole of the slaughterhouse, the depth decreases, and for navigating it is necessary first, to keep

the bow in the direction of the « Guaviyú » island and, after having passed the creek of this name, to keep it in the direction of the « Arroyo Grande » (Sheet *E*).

The cube to be dredged, so as to make this bar suitable to navigation with riversteamers, is 56.000 cub meters. It must be indicated by 8 buoys and a line of beacons on the Oriental coast.

The Western channel might have been selected as the one to be deepened, as its direction is nearly straight and perhaps its maintenance would be easier, but the cube to be dredged would be double as much. Also the slaughterhouse of « Guaviyú » being an Oriental port, where the river steamers, which serve both coasts stop, (which latter circumstance ought to be kept in account); the deepening of the Western channel would cause them a loss of time in consequence of the curve they would have to make in order to avoid the great bank in the middle of the river. For this reason the intention is to deepen the actual route as it is thought that by doing so more practical results will be arrived at.

The general depth of the river, which, as we have seen, diminishes after the stretch of the bluffs of San José has been passed, does not increase again after the shallow bar of « Guaviyú », on the contrary, the greatest obstacle of the middle Uruguay, the bar of « Chapicuy », is met with at a short distance.

Stretch of « Chapicuy ».

In the part of this Report, which refers to navigation (page 11) the great inconveniences, which this shallow part of the river causes during several months, have been mentioned and were it not for the extraordinary tides, the influence of which may be felt in the Port of Concordia, it would make navigation of this zone of the river completely impossible.

Bar of « Chapicuy ».

This obstacle is formed by a shallow place (bar) of sandy stone, which acting like a weir, detains the material which the current brings away from the bluffs of the plateau of « Artigas » which excavation is the origine of the formation of the first islands of the middle Uruguay and of the sandbanks which form the bar of « Chapicuy ».

From the borings, carried out at this bar, results, that the

Result of boring.

rock is formed by compact sand stone covered by 1,50 meters of sand. This rock has a depression which follows the very thalweg of the river, allowing therefore the dredging of a channel with 9 feet of depth with exception at the one place, where sand stone is found at a depth of 2,32 meters.

A little above this bar, the depression formed in the hard sandstone seems to divide itself in a direction towards the Argentine coast in front of the arroyo «Mellado», passing between two banks formed by sand and gravel.

Even if it were true that this depression continued till the curve of 3 meters depth, (which however is not likely to be the case), it is believed that a channel cut in this direction would be difficult to maintain, as it is situated between banks, the dimensions of which have augmented considerably as appears from a comparison of the figured plans of 1890 and 1900.

The contrary is observed in the channel passing the middle of the river, and as the bank in front of the island of « Chapicuy » has disappeared, there is reason to believe that once, when the bar of sand stone in the extreme south of the channel has been levelled, the result of this work will be the absolute maintenance of its upper part, the more so as the projected direction corresponds exactly with the thalweg, which form corresponds to the layer of sandstone.

As for the other project in the direction O. P., though its upper mouth would have the advantage of being better defined, the borings have shown the ground to be impenetrable to the boring tool at a depth less than 2,74 meters, reason for which the acceptance of this direction must be rejected.

The channel was therefore projected in the middle of the depression, which is impenetrable to the boring tool, but the curve of the channel makes it necessary to increase its width to 80 meters.

Comparison
between the two
directions.

It is very useful to compare the cube necessary to be excavated for a curved as well as for an absolute straight channel which unites the curves of 3,00 meters depth and which therefore is done below :

Channel in a curved line		Channel in a straight line	
Rock.....	16.000 M ³	Rock.....	51.5000 M ³
Sand and gravel.	256.000 „	Sand & gravel....	192.000 „
	<u>272.000 M³</u>		<u>273.500 M³</u>

From these figures results that the channel in a curved line is the most convenient, as the difference in cube of sand to be dredged is little, where as that for breaking up and excavating sandstone is very visible.

In order to see the result which the opening of the channel might effect on the regime of the river in this part, gauges have been placed which are based on a precise levelling which has been continued as far as the « Estancia Humaitá ».

Local slopes.

With the observations which have been made simultaneously the mean slopes have been determined for different sections and the heights of water resulting from their examination that even if the formation of the uniform slope over the whole extension of the bar were to take place, after the execution of the works of canalization, this would not unfavorable modify the regimen of the river in this zone, which, as has been seen, is navigable during a low river, not in consequence of the quantity of water it brings down, but for the periodical high tides, which maintain the water sufficiently high during three or four days.

On the contrary, it may be taken for sure, that by opening the channel as projected, giving it a width of 80 meters by levelling the shallow places of sandstone, this will help to maintain the upper portion, in consequence of the increased slope which will be established.

It is intended to mark this channel, in consequence of its curved direction, with ten buoys, which position will be referred to two fixed points placed with this object on the island of « Chapicuy ».

The last maned shallow place having been passed, the river can be navigated with great facility, following the

Stretch of « Yeraú »

center of the river, till the arroyo «Hervidero» is reached. where the bottom formed by rocks begins.

Hervidero bar.

The extension of the «Hervidero» bar is about 3.800 meters, the principal shoals existing in the very center of the river (Sheets C and C').

Western route
6 feet.

In order to avoid those rocks, navigation at present follows the Argentine shore, the direction being indicated by two buoys placed by the riversteamer Companies and the Oriental Government. The number of those buoys is generally three, which are situated in the upper part of the bar; the first and the last are left to the West and the second one, which marks a great shoal which is visible when the river is very low, is left to the East. Following the described direction 6 feet of water will be found when the river is very low, but the bar can also be passed leaving the great shoal to the West and in this case the maximum depth found is 8 feet.

Eastern route
8 feet.

The last named direction, which is known by the pilots, is at present not used, not only for being more curved than the other but also because the navigability of this part of the river depends on the «Chapicuy» bar where there is only 2 1/2 feet of water under the same condition when the river is low.

However it may become useful some day when the other bars that of «Chapicuy» included, have been deepened, but it will then be necessary to explore it first carefully in order to extract some loose stones, which are supposed to exist, besides buoying it.

Projected works.

In order to make this bar navigable in conditions of perfect safety, a nine feet channel in the center of the river has been projected, which can be marked by signals placed in its direction on the Argentine shore.

Marking of the
channel.

The greatest attention has been given to the marking of this bar, so that vessels may cross it during day and night with complete safety.

At present the steamers leave the docks of Buenos Aires at 10 o'clock a. m. with the object to arrive the next afternoon at Concordia and Salto, where the operation of loading and unloading are immediately carried out, in order that they may be able to undertake the return voyage next day.

The delays the steamers suffer when going up river, may cause them to arrive at the «Hervidero» bar after dark, obliging them to anchor till the following day, losing by doing so one night, not to mention the losses and annoyances caused to the passengers.

On the other hand it is very difficult to anchor buoys in this part of the river in consequence of the nature of the river bed and of the strong current—3 meters per second—when the river is high; and if this were to be attempted at least 30 meters of chain are required, the result being that in periods of low water those buoys could not indicate the channel with sufficient exactness.

For all those reasons the channel has been projected in the center of the river and it will be indicated by direction lines on the shore.

The rocky bar of «Hervidero», is mainly formed by loose stones, of an average weight of one ton, which can be easily extracted with Priestman's excavators. The quantity to be removed is about 19.000 m³.

After having passed the last shoal of the «Hervidero», navigation, in the curve formed by the river is easy, till the mouth of the arroyo «Yuquerí Chico» is reached (Sheet *B*). DAYMAN CURVE.

A little above this arroyo the bar carrying the same name is met with, which owes its existence to the little elevation of the shoals and the concavity formed by the river (Sheet *A*). The bottom consists of gravel and the cube to be dredged is 44.500 cubic meters. This dredging must be completed by establishing a direction line of beacons, to be erected on the Argentine coast, and 4 buoys. Yuquerí Chico bar.

Navigating in the center of the river there is sufficient depth for the river steamers till arriving at the mouth of the arroyo «Yuquerí Grande».

In front of the mouth of said arroyo begins the bar of «Yuquerí Grande», a shallow place formed by gravel and remains of stones which the current brings down from the «Corralito» bar (Sheet *A*). Bar of Yuqueri Grande.

Two directions for a channel have been studied, the first one in a straight line, forming the prolongation of the channel projected in the rocky bottom of the «Corralito» bar (Sheets *A* and *A'*) and for which a cube of 51.000 m³

must be extracted, but it will be noticed that this direction cuts a shallow place near the Argentine coast, where probably rocks will be found.

For this reason it is believed that it is more convenient to adopt a direction partly straight and partly curved, following the thalweg of the river giving at the same time a width of 60 instead of 50 meters to the channel. It is almost sure that adopting this direction no rock will be met with and the cube to be dredged will be reduced at the same time to 30.000 m³.

As the bars of «Yuquerí Grande» and of «Corralito» form in reality one single bar, being the first one, as explained before, a consequence of the second, it has been agreed upon to give the name of «Yuquerí Grande» to the whole part which bed is gravel or small stone, and that of «Corralito» to the part where the bed is completely of a rocky nature.

Corralito bar.

Immediately upstream the «Corralito» bar is found, the formation of which is compact stone in the middle of which exists a narrow channell. When taking the level of the water surface in the part above and below the bar, when the height of the river water was 0,62 meters a difference of 0,40 meters was found over a distance of 2237,20 meters, that is to say a slope of 0,183 meters per kilometer.

The corresponding mean velocity observed at the surface was 0,92 meters the greatest velocity, 1,26 meters per second. Other observations made when the height of the river was 2,50 and 3,80 meters gave as a result velocities of 1,382 and 1.398 meters per second.

In order to navigate the «Corralito» channel, the following buoys, all near the Argentine shore, will be placed when going upstream, three at the beginning and four at the end.

In the plan of the works for deepening permanently this part of the river for navigation with vessels drawing 9 feet, a direction in a straight line has been adopted, which follows as much as possible the existing channel and reduces the excavation to be executed to a minimum.

The cube of the material which must be broken up and excavated is 17.700 meters. The marking of this bar and that of «Yuquerí Grande» must be done with buoys pro-

vided with lanterns, which will be placed under the charge of a special guard (watchman) ; the number of the buoys will be 12, 6 on each side.

After the « Corralito » bar has been passed there are no more difficulties as far as Concordia, the depth in this port in front of the Harbour Police Office being 15 meters.

The river continues very deep as far as « Salto Chico » but en the Argentine coast past the mole of the slaughterhouse of Concordia there are many shoals amongst which deserves to be mentioned specially the one called « La Caballada ». It is met before arriving at the Oriental port of Salto, obstructing the river and leaving only an opening towards the Oriental shore of about 80 meters.

As has been observed in the foregoing description, of the zone between Concepción del Uruguay and Concordia, the inconveniences that difficult navigation drawing 9 feet are numerous, but with exception of the bad passes « Chapicuy », « Hervidero », and « Corralito », the rest can be easily removed. The marking of the channels to be opened is also easy and can be done by directions on shore, which already have given good results at the bar of « Altos y Bajos » and « Banco Grande ».

From the quantities, which are given, results that the maximum cube to be dredged or excavated in the different shallow places is as stated in the following table:

**GENERAL QUANTITIES OF THE WORK TO BE
CARRIED OUT TO OBTAIN A DEPTH
OF 9 FEET TO CONCORDIA**

NAME OF THE BARS	SAND AND GRAVEL	ROCKS	TOTALS
Peruchoverne.....	M ³ 92.000		92.000
Pepeají.....	100.000		100.000
Cancha Seca.....	22.000		22.000
San José.....	50.500		50.500
Sombrerito.....	6.300		6.300
Guaviyú.....	56.000		56.000
Chapicuy.....	256.000	16.000	272.000
Hervidero.....		19.000	19.000
Yuquerí Chico.....	44.500		44.500
> Grande ..	30.500		30.500
Corralito.....		17.700	17.700
	<u>657.800</u>	<u>52.700</u>	<u>710.500</u>

All the cubes have been calculated for a depth of 10 feet and have been increased with some 20 % in the case of sand and gravel and with some 30 % in case of stone, they represent therefore the maximum work and the complete solution of the problem.

**PROVISIONAL REDUCTION TO 8 FEET OF THE
DEEPENING FROM CHAPICUY TO BELOW
THE CORRALITO**

As it may happen that it would not be possible at present to dispose of the necessary elements to undertake the canalization of the bars which are of a stoney formation, the deepening of the bars of « Chapicuy » and of those situated above the latter must be reduced at present to 8 feet (2.40 meters).

By this provisional solution the cube to be dredged would be reduced to some 500.000 M³, to which ought to

be added unimportant work to rectify and to clean the eastern channel of the « Hervidero » bar.

With a depth of 9 feet at the bars situated between the Concepción del Uruguay and « Chapicuy » and of 8 feet between the latter and Concordia, the conditions of navigations in those parts of the middle Uruguay would have improved considerably.

The coastwise navigation would no longer suffer from the consequences of a prolonged state of a low river and the port of Concordia would be permanently accessible to it.

What concerns the river steamers, they would nearly always be able to reach the latter port, sometimes transhipping into lighters would have to take place below the « Corralito » bar and more exceptionally yet below the « Hervidero » or « Chapicuy » bar, as easily can be comprobated by an examination of the curves of the height of water at the ports of Nueva Escocia and Concordia.

The buoying of the middle Uruguay ought to be carried out as far as the port of Colon with luminous buoys for the same reason for which this system has been proposed for the Lower Uruguay.

Buoying.

It would be necessary to place this class of buoys at the following points:

At the South point of the « Almirón » island.	one
At the North point of the Oriental island...	one
At the bar of « Almirón »	four
At the shoal of « Curtiembre » (Tannery)..	one
At « San Francisco » bar.....	six

being a total of thirteen luminous buoys in this section of the river. From Colón to Concordia it is intended to use cylindrical buoys 1,50 meters long by 1,00 meter diameter, with sights and rudders; at nearly all the bars the buoying would be completed by directions on shore, indicating the center of the channel, and which if provided with lights, would make navigation of these bad bars easy even if during night time.

Cylindrical buoys have been adopted, as their construction is cheaper and because repairs can be easaly executed.

As the beacons in alignments can nearly all be erected in places which are out of reach of the highest water, their construction, installation and maintenance will be fairly economical.

GENERAL PROGRAM OF THE PROJECTED WORKS

By the aid of all the preceeding antecedents and the detailed list of the work to be executed for the improvement of the river to Concordia, the corresponding estimates have been prepared.

Determination of
the unite princes

For the purpose of establishing the schedule of prices for dredging, the plant which the General Inspection actually disposes of, as well as the cost of the work already carried out by this Commission at the bars of Banco Grande, Altos y Bajos and San Francisco, have served.

Breaking up and
extraction of rock.

With reference to the breaking up and extraction of the bars of rock it is believed that the first operation can be executed with explosives and also by heavy bars and rams, which are allowed to drop from some height and for which an installation can be made; the second with Priestman's crab excavators.

The use of the falling ram is indicated to level the shallow parts formed by sandstone of the «Chapicuy» bar, and that of the explosives to break up the blocks or layers of compact rock of the «Hervidero» and «Corralito» rock.

At the two last named bars and specially at the first one the work of extracting the stone will be notabaly reduced in consequence of depth existing near the places where the explosives will be used.

The Priestman's crab excavators can be erected on and worked with perfect ease on board of steam hopper barges, the holds of which ought to be lined before hand with timber in order to transport and discharge the extracted material.

In this condition and by working in a rational manner, it is believed that the excavation and extraction of the stones can be done at a maximum cost of 5 dollars national

currency, and that this price will be notably reduced if special tools could be provided, with which also the work of the improvement of the Upper Uruguay could be initiated.

With reference to the workmen, as labourers, sailors, miners, firemen, etc. it can be said that they are of a very good class and that they may be secured in the different ports of the River Uruguay. For this reason the interruptions caused by the great rises of the river, will be of little influence to the cost of the works.

Facility which exists in getting a good class of lower personnel for the work.

The ordinary buoys which are intended to be placed are of about 0,750 M³ of displacement, and will be anchored with chains of 25 milimeters diameter and of a length equal to double the depth at the highest river.

The towers or beacons for indicating directions have been designed of angle iron $\frac{80 \times 80}{10}$ milimeters and are 8 meters high.

The advantage of their use (besides an other principal one, which will be indicated further on) is that they can be changed into a luminous demarcation under economical conditions.

The huts, which are provided for guards, are destined for the watching and the service of maintenance of the demarcation of the principal bars of Chapieuy, Hervidero and Corralito.

In order to estimate the cost of the luminous buoys to the Port of Colon, which port is navigated by the river-steamers during night time, the prices of the contract with Messrs. Dirks & Dates of the 10th of January 1899, for a similar work executed in the River Plate, have been taken.

The total cost of the works mentioned amount to seven hundred and thirteen thousand eight hundred and five dollars national currency (\$ 713.805 n/c) and Two hundred and five thousand four hundred and seventy three argentine gold dollars (\$ 205.473 gold dollars).

Total cost of the works.

In order to carry out the works within two years it is necessary to complete the dredging plant of this Commission with the following elements:

Necessary elements to complete the dredging plant of the river Uruguay.

One bucket dredger of an average monthly work of 20.000 cub. meters (C 4).

One towboat (204 B).

Four ordinary hopper barges.

One mud pump, transformed into suction dredger (C 12).

One steamer for inspection (B 105 type).

With these elements added to the dredger «9 C» and «11 C» a monthly cube of 84.000 meters may be dredged and calculating 8 months of work for every year (taking into account the losses caused by high water or repairs) a total of 1.344.000 M³ will be excavated at this rate, which is a difference in favour of about 200.000 cub. meters. Therefore as far as dredging is concerned, the working plan can perfectly be realized.

Besides these elements, the acquisition of which is foreseen in the price calculated for this class of work, it would be useful if for the breaking up and extraction of the stones, two steam hopper barges were provided.

What the ordinary buoys and beacons concerns, considering their quantity it might be convenient to have them made by private contractors so that they will be promptly ready for placing, and facilitate the execution of these works.

Time it will take
to canalize the
river.

The plan of the work having been clearly explained, its practical results might be doubted, specially with regard of the deepening of the shallow places.

It has been observed when describing the River Uruguay and the different bad bars, which are an obstacle to navigation, that the river has a very reduced slope and that its banks are firm. The shallow places with their details of orientation and depth have remained the same, as has been proved by comparing different surveys made before, with those made by this Commission.

The cause of the relative stability of the shallow places and specially of these where the direction of the current is always the same, is the great adherence and conglomeration between the materials, which is so great that the suction dredger of this Commission is not able to lift them, though the velocity of the water in the suction pipe is 3,50 meters per second.

It is therefore expected that the canalization of the bars, which are in these conditions, when executed, will be of easy maintenance. They represent more than half the cube

to be dredged as may be seen from the following list: San Francisco (129.000 M³), Peruchoverne (92.000), Pepeají (100.000), Chapicuy (272.000), Yuquerí Grande (25.000).

With reference to the maintenance of the other bars, which are formed by the change of the current according to the different heights of the river as for instance that of the Cancha Seca (22.000), San José (50.500), Sombrerito (6.300), Guaviyú (56.000), Yuquerí Chico (44.500), it is believed that it will be necessary to dredge after each great rise of the river, about 60.000 M³, supposing that the filling will represent a third part of the cube originally taken out. Besides, it has already been proved that for maintaining the bars of «Banco Grande» and «Altos y Bajos» the working capacity of the suction dredger is one third more.

It is therefore possible to assure that, with two suction dredgers, the «C 11» and an other one of those acquired for the dredging of the Martín García channels, it will be perfectly feasible to attend the canalization of the river Uruguay and to improve it, for which it will be only necessary to work the dredger during six months in the year, which represents an annual expense of \$ 36.000 national currency. It might be observed that as the silting may take place suddenly and as its removal by dredging takes some time, the navigation in consequence might be interrupted during a longer or a shorter time after each flow of water.

Probable cost of
the canalization.

With respect to such an observation the answer would be, that however suddenly the river falls, this always takes place little by little from below to higher up river; for instance, when the water marks yet 2,40 meters at the gauge of Concordia the river steamers have not enough water to pass the «Peruchoverne» bar.

But this inconvenience has all the same been taken into account and in order to eliminate it as far as possible the marking of all the bad bars by alignments on shore, where the coast allows to do so, has been adopted.

By the aid of those signals which are if possible, erected out of the reach of the highest floods, the channel is absolutely lined out and even in case the buoys, which

mark its width disappear, the engineers in charge can immediately know to what extent silting up has taken place when the river begin to lower in its superior part, as they are warned of this by direct telegraphic communication. In this way there is the necessary time to remove the partly filling over a reduced width, to complete this later on over the entire width between the buoys.

It may be assured that three fourth parts of the work to be carried out in sand and gravel will be a permanent improvement and that it will be necessary to maintain the rest, but this maintainance will become less in time because it is believed that the sand is not kept in suspension and only brought down during the great flows of water, and that in consequence the first filling of the channels during a high river is therefore due to the steep slopes and great difference of the height of the bottom immediate to the channels cut through the bars.

In short, the improvement of the navigability of the River Uruguay in the conditions as explained is a work easy to carry out and of great consequence if carried out with the necessary speed, method and energy.

As the plan of the works are based on studies sufficiently complete for the object in view, and as already dredging works and demarcation by signals has been carried out, which so far have given a good result, there is much reason to believe that in the relative short time of two years, all the obstacles, which now difficult navigation to Concordia, will have disappeared, if the approval of the Superior Government can be obtained and if the necessary means can be disposed of.

Studies that would
be convenient to
finish.

With the surveys realized up to this date it has been partly possible to study the regimen and conditions of the River Uruguay, in order to design the necessary works of improvement for navigation; the part situated between Concepción del Uruguay and the River Plate has only been surveyed and studied partly, and this work has been completed by a general recognizance. For this reason those estudios will be continued in this part of the river, which, it may be stated is yet unperfectly known, specially the part between Fray Bentos and Concepción del Uru-

guay as is proved by the many errors which the English Chart of this zone contains.

It may be hoped that by continuing the studies of the River Uruguay in the same manner as at present, that there will be within the time of two years all that is necessary for the realization of the present program of works, that a complete chart of the river will be finished, which not only will render great services to navigation, but which will also serve as a base for other works for the improvement of the navigation in the Lower Uruguay, which will undoubtedly be necessary after the canalization of the bars of Martín García has been finished.

I am pleased to be able to state that in the execution of the plans etc., forming part of this study, I have been very ably assisted by the personnel of the Commission and specially by the 2^d Engineer in Chief of this Commission Mr. James Pigazzi, and the assistant engineers Messrs. Robert Dubosq, Henry Widmüller and Ramon Celinski, who I, for this reason recommend to the consideration of the Superiority.

November 1901.

JULIO HENRI.

Chief Engineer of the
Commission of the Uruguay River.

ANNEX

Short description of the studies and works which have been carried out during the years 1902 and 1903.

MIDDLE URUGUAY

A precise levelling carried out from Buenos Aires to Concepción del Uruguay and from there to Concordia has affirmed the approximative results obtained by the studies of the propagation of the tides in the Uruguay River, which showed that the slope at a low river is small and that the river, even during the months of extraordinary low water, is navigable as far as the last named port.

In accordance with the project for the improvement of the Uruguay River, the dredging of the San Francisco Bar, the first of the many which obstruct the river navigation to Concordia was started.

SAN FRANCISCO
BAR.

In this bar, the low part of which is formed by gravel and the upper by sand, a channel has been opened 100 mts. wide and 2000 mts. long. After it had been dredged for the first time, some unimportant silting has taken place in its superior part, where the bottom consists of fine sand, which has been removed since. At present there are 9 feet of water at this bar at extraordinary low water, whereas before its dredging, there were only 5 feet. The formation of the channel through this bar has been completed by marking it with 2 towers in line on shore, which are lighted during night, and 4 ordinary buoys.

CHAPICUY BAR.

After the dredging of the San Francisco Bar had been finished, that of the Chapicuy bar was undertaken with the object to establish there the same condition of navigability as at the other bars where there is 5 feet of depth at extraordinary low river, whereas at the Chapicuy bar there was only 2 $\frac{1}{2}$ feet.

In consequence of the hard material found in the bed of the river, and as there was no plant at hand to deal it, the channel was lined out in a curve following a natural depression in the riverbed.

The result of the dredging has been that at present vessels of 4 $\frac{1}{2}$ feet draught can cross the bar, however low the river may be.

PERUCHOVERNE
BAR.

This bar, which is the second of the many met in the Middle Uruguay where there is less than 9 feet of depth, is actually being dredged.

The material at first extracted by the dredgers was very hard and consisted of conglomerate of gravel, but this conglomerate was only found over a short distance. The material dredged afterwards is fine sand and gravel.

LOWER URUGUAY

During the year 1902, the studies and surveys of the River Uruguay have been extended South of the town of Concepción del Uruguay and therefore embrace that part of the river which is called *Lower Uruguay*.

The river, which between Concordia and Concepción del Uruguay is formed by one single navigable channel—with exception of a few unimportant arms and islands—has a width varying from 800 to 1500 mts. and divides itself below the last named town into two arms—one which can be used by vessels of great draught and the other by the river or coastwise navigation—which form a great number of small and large islands, the distance of the shore of the main land varying from 10 to 12 kilometers.

The only obstacles for the ocean navigation, which always follows the main arm of the river, to go as far as Concep-

ción del Uruguay were the bars of «Altos y Bajos», «Montaña», «Banco Grande» and «Roman».

The dredging works, which have been carried out at the mentioned bars, have given very satisfactory results; the channels have maintained their depth since the first dredging was carried out and it has only been necessary to make some local corrections and to clean them occasionally.

The «Altos y Bajos» and «Banco Grande» bars, which completely prevented navigation and where only existed a depth of 11 or 12 feet at low water, are now crossed by a channel where there is always more than 18 feet of water.

The width of the channel through the «Altos y Bajos» bar is 200 mts., and that through the «Banco Grande» bar 150 mts. and of that through the «Montaña» bar 100 mts.

The channel through the first two bars is marked by two towers placed in line on shore and which are lighted during night.

The part of the river Uruguay, which is least known, is that situated between the River Gualeguaychú and Palmira. In this entire section of the river, there exists only a narrow twisted navigable channel, which almost disappears in what might be called a lake from 8 to 12 kilometers wide. The channel is therefore difficult to navigate as well for ocean as for coastwise vessels.

The channel, though generally deep, is, as already has been mentioned, full of bends and if not marked by beacons and buoys difficult to navigate.

In this entire zone, the channel is enclosed by steep and hard banks or an extensive strand formed by mud, where there is only a depth of one meter. Between those banks the navigation channel passes, which at some places is only 300 mts. wide, but where depths from 50 to 60 feet are found.

Navigation of this part of the river is only possible by using continually the sounding lead, as well during day time as at night and is generally interrupted at sunset unless the services of an experienced pilot have been secured.

During this month (September 1903) the buoying of the lower Uruguay over a distance of nearly 100 kilome-

ters, by means of luminous buoys will be completed and consequently navigation will then be as easy at night as by daytime.

In the part of the river under description (from the river Gualeguaychú to its mouth) there are only two places in the navigable channel where the depth is less than 18 feet. They are the « Barrial » bar and the « Punta Caballos » bar.

BARRIAL BAR.

Before arriving at the mouth of the River Gualeguaychú, the navigable channel disappears to be found again at some distance. Those two parts of the channel are separated by a bar formed by sand and thin mud, to which latter the bar owes its name. At this bar, which must be crossed in order to pass from one channel to the other, there is only 13 feet of water at exceptionally low tides. After the surveys have been concluded, it has been found, that the bar becomes narrow towards the North forming a gorge consisting of sand being only 800 wide. It is at this place that the channel to be excavated, for joining up the deep waters, has been projected. The cube to be dredged is about 300.000 M³. After this dredging has been carried out the new channel will be marked by luminous buoys, so that vessels will pass safely.

**PUNTA CABALLOS
BAR.**

After the last described bar, the only shallow place in the River Uruguay till its mouth is the « Punta Caballos » bar. It is situated a little above the mouth of the Río Negro and is also formed by a long and narrow bar which blocks the navigable channel. The material to be dredged is sand, the quantity to be extracted being only 20.095 M³. After this bar has been dredged the channel formed will also be marked by luminous buoys.

Both channels will be dredged to a width of 200 mts., and as the Argentine Government has just made an arrangement with a firm of contractors, to execute this work, it is supposed that before May of next year there will be in the River Uruguay from Colon to its mouth the depth as has been established in the project of this Ministry of Public Works for the improvement of the navigability of this river.

PORTS

As the intention is to construct for this port, works, which will allow the loading and discharging of vessels, whatever may be the state of the river, which yearly differences of water are from 10 to 12 mts. and exceptionally as much as $14\frac{1}{2}$ mts., it is clear that those works will be very expensive. The importance of the sudden rise and fall of the river at this port will be yet better understood by mentioning the fact, that the river is known to have risen more than 5 meters within 24 hours.

CONCORDIA.

The work to be carried out will give the bank of the river an uniform paved slope, so that the vessels may be moored against floating pontoons, secured by anchors and which will be able to alter their position according to the height of the river. The pontoons will be connected to shore by means of small bridges.

A project has been made for a wharfing at which river-side steamers and larger coastwise vessels can operate and also for a small basin for the smaller coastwise vessels.

COLÓN.

The works will be started within a short time and when finished will contribute much to facilitate the exportation of the products of the many important agricultural colonies, of which Colón is the center.

The minimum depth at lowest river to reach this port is now 9 feet, but it is intended to increase this depth to 15 feet; the wharf having been projected so as to allow the deepening of the river to be carried out longside her.

There will also be constructed a small brick warehouse.

This port is continually being improved in order to facilitate the operations of ocean vessels.

CONCEPCIÓN DEL
URUGUAY.

Besides the wharfing in the main branch of the River Uruguay, the dredging to widen the entrance channel to the interior port and to deepen it to 11 feet, is in progress. Its depth will be increased in future to 17 feet.

The works carried out in the interior port, which is situated in a branch of the river, as a quay wall, railway lines, connecting it to the system of the Entre Rios Ry Co. have much contributed to increase its importance and

within a few years it will be necessary to extend those works so as to transform the interior harbour into a very safe port for all class of vessels coming to the port of Concepción del Uruguay.

When the dredging of the « Barrial » and « Punta Caballos » bar has been carried out it will be accessible under all circumstances for vessels of 19 feet draught.

PORT UNZUÉ
ÑANDUBAYZAL.

In the year 1902 the Argentine Congress granted a concession to Mr. Saturnino Unzué for the construction of a port on his property situated on the River Uruguay on the Argentine shore opposite and a little above Fray Bentos. The project consists of a wharfing which provides accomodation as well for ocean — as for coastwise vessels. The island Abrigo in front of the projected works, protects them against Southern winds. The natural depth of the river is sufficient for ocean vessels, without requiring dredging. The port will be connected by a railway to the town of Gualeguaychú and with the general Entre Rios Railway system. Though not yet at present, it is intended to construct in future a factory for frozen meat and a grain elevator. The plans for this port are at present at this Ministry for examination and approval.

GALEGUAYCHÚ.

The port of Gualeguaychú, situated on the river of the same name, is at present, as has been said before only accessible for coastwise vessels of very small draught. In the year 1902 Congress granted a concession to Engineer Sobral for the execution of works to improve it so as make the town accessible for ocean vessels, but till at present no works have been carried out.

As the concession « Sobral » ended in November 1903, this Ministry of Public works has completed now the necessary surveys and studies for the improvement of the entrance channel and the Gualeguaychú river, and Congress having granted \$ 100.000 gold for the works, the town of Gualeguaychú will soon be accessible at lowest river for coastwise vessels of 7 feet of draught.

St. LOUIS EXHIBITION

(UNITED STATES OF N. AMERICA)



EXPLANATORY INDEX

OF THE

OBJECTS EXHIBITED

BY THE

MINISTRY OF PUBLIC WORKS

OF

ARGENTINE REPUBLIC



DIRECTION GENERAL OF HYDRAULIC WORKS

MILITARY PORT OF BAHIA BLANCA * * *

DEPARTMENT OF ENGINEERS OF TUCUMAN *

NOTE

The objects exhibited by the Ministry of Public Works of the Argentine Republic and presented by the Direction General of Hydraulic Works, have been divided into five groups:

- I. — RIVER PLATE.
 - II. — RIVER PARANÁ.
 - III. — RIVER URUGUAY.
 - IV. — MILITARY PORT OF BAHÍA BLANCA.
 - V. — MASONRY DAM AND RESERVOIR FOR THE IRRIGATION
WORKS OF THE PROVINCE OF TUCUMÁN.
-

Direction General of Hydraulic Works

I. — RIVER PLATE

This great plan executed in relief to the scale of 1:40.000, and covering an approximate area of 3500 square kilometers, shows clearly all the particulars of the bed of the Upper River Plate. With its aid the numerous channels and banks that exist and also the great number of rivers that form the Paraná Delta, as well as the situation of the luminous and other buoys and signals destined to facilitate navigation, can easily be seen.

This plan also shows the Ports of Buenos Aires and La Plata, with their entrance channels, buoys and beacons, by means of which the access to them is facilitated.

Six maps have been put up in album form; the following is a short description of them:

After having finished the survey of the Upper part of the River Plate the navigable channels have been buoyed. This is one of the most important works carried out. The buoys indicate precisely the route to follow, avoiding, by doing so, the groundings that were formerly so frequent, and that caused so much detriment to the general commerce.

The luminous buoys, of 5 cubic metres capacity, burn night and day, the greater part of them being supplied with mineral oil gas and the rest with acetylene gas. The gas is taken to the buoys by steamers provided with storeholders which are loaded with gas from a gas factory; both the steamers and gas works were specially constructed for this purpose on the Pintsch Patent Lighting system.

This plan is a resumé of the results of the survey carried out by the staff of the Ministry of Public Works of the

I. PLAN IN RELIEF
OF THE UPPER
RIVER PLATE.

2. ALBUM WITH
MAPS OF THE
RIVER PLATE.

Plan No 1.—General Map of the luminous buoying of the River Plate — Scale 1:20000, Year 1902.

Map No 2.—General Map of the River Plate.

Nation up to 1903, and embraces the upper part of the River Plate.

This survey has been carried out with great care by means of a great number of soundings and cross sections, and close observation of tides. An excellent triangulation covers completely the studied zone. This plan also contains the position of all the signals for navigation that exist on the River.

Map No 3. — Uruguayan shore of the Upper River Plate.

The problem of the interior navigation of the Paraná- and Uruguay Rivers being based on the navigability of the channels near the Uruguayan shore of the Upper River Plate, this map has therefore been prepared on a large scale which allows it to be perfectly studied, there being an abundance of details.

Map No 4. — Outer Roads of Buenos Aires. Year 1903.

This map, drawn to the scale of 1:40000, embraces the part of the River Plate in front of the City of Buenos Aires, including its Port, the access channels, and the manner in which the latter have been marked with buoys and beacons.

Map No 5. — Farallon Bar, Scale 1:40000.

This map embraces with many details the zone of the River Plate where there is less depth in the route of navigation of ocean vessels. All the buoys and the position of all rocks that may be dangerous to navigation in the proximity of the Farallon (Colonia Lighthouse) are indicated.

Map No 6. — New Channel, scale 1:100000, Year 1903.

This channel was buoyed for the first time in the year 1892, the passing of vessels and the effects of the current have produced a natural excavation of 3 feet. This channel has at present 19 feet at low water, and the luminous buoys greatly facilitate its navigation.

3. MODEL OF THE GRAVING DOCK OF THE PORT OF BUENOS AIRES.

The port of Buenos Aires has two graving docks, one 180 meters and the other 150 meters long. This model represents with all details the largest of the two to a scale of 1:100. It shows the culverts for emptying the dock, the engine house, the floating caisson and all details of its construction.

4. Luminous Buoying of the Entrance Channels to the Port of Buenos Aires.

This plan indicates in detail all the signals, luminous- and other buoys and beacons that mark the access channels to the Port of Buenos Aires, the position of the Semaphore and the form of signals most commonly used for the buoying.

This album is a collection of photos of the various types of dredgers, the tug boats, and other craft belonging to this Ministry. There are also some photos of important works executed and in execution, that give an ample idea of the forward state and progress of public works in the Argentine Republic. Annexed to the album there is an index of the photos it contains.

Photograph Album

This is the last plan prepared by the Ministry of Public Works of the Port of Buenos Aires in its present state. It shows the general disposition of the Port, and contains also the channels, the Riachuelo Port, Southern Dock, etc. On both sides of the Riachuelo there exist good timber wharfs that allow of ocean and coasting steamers being moored to them. On the Southern shore of this river 1200 meters of wharfing are now under construction.

6. Plan of the Port of Buenos Aires.

Where the South Entrance Channel commences the Ministry of Public Works has its workshops, where the repairs to the dredgers and other craft are carried out. In the North Basin are installed the graving docks and workshops which belong to the administration of the Ministry of Marine.

To give an exact idea of the importance of the Port of Buenos Aires, three Panoramas taken from different places are also exhibited. They show the traffic of ocean steamers and coasting craft.

7. Panorama of the Port of Buenos Aires

This album contains photos of the steamers and other vessels for all the different services of the Ministry. At the end of this description there is an index of all the craft.

8. Photos of Vessels belonging to the Ministry.

II. RIVER PARANÁ

The importance of the studies of the Paraná River in front of the City of Rosario (on the occasion of competitive tenders for the construction of its Port being called for) has motivated the preparation of this plan. It shows the curves for every meter difference in depth of the bed of the river, and its general formation, as well as its other peculiarities, such as banks, channels, etc.

1. Plan in relief of the River Paraná in front of Rosario, Scale 1:20000.

2. Plan in relief of the River Paraná in front of the city of Paraná, Scale 1:10000.

This plan was constructed, as was the preceding, with the object of showing in a plastic form the results of the surveys which were carried out to serve as a basis for a project for a Port for the City of Paraná. For its construction the same method was followed as for that of Rosario, the curves of depths show the differences from meter to meter and embrace all the zone that was studied in order to select the best location for the future port.

3. Portfolio of Maps of the Lower River Paraná.

The entire course of the River Paraná to its mouth in the River Plate has been divided into three sections named respectively Upper-, Middle- and Lower Paraná. The first section embraces the part of the river between Corrientes and Santa Fé; the second that between Santa Fé and Rosario, and the third that between Rosario and the mouth of the Guazú; the approximate lengths of these sections are 508, 160, and 420 kilometres respectively.

The aforementioned portfolio contains in 16 sheets the map of this section of the River to a scale of 1:20,000.

ROSARIO-RIVER PLATE; One index sheet to the scale of 1:100000. This plan indicates the relative position of the different sheets which constitute the total survey.

This survey is based on a triangulation which takes in the two shores, the vertices are used as reference points to fix the profiles of the soundings. These have been carried out at variable distances, from a maximum of 200 metres at points where great depths are found and navigation is easy, to a minimum distance of 20 metres in the parts where there is little depth, and where, therefore, the soundings for each section are numerous and most closely taken in the most interesting parts; the position of each sounding is referred to red signals on shore. The constant observations at two automatic registering gauges erected in Rosario and San Pedro, and at ten ordinary permanent gauges placed at different points of the river during the execution of the survey, gave the necessary elements to reduce the heights of water observed to the hydraulic zeros. Besides these permanent gauges, temporary gauges were also erected and continuously observed at the most important points, as at the bars and shoals, during the time they were surveyed.

The maps in the portfolio have been compiled from these

surveys. The bed of the river is shown by curves of depths taken at distances of one meter. The list of all the maps contained in this portfolio, with the details of each, is given in the Appendix.

This contains 8 sheets on a scale of 1: 20,000 and one index sheet on a scale of 1:1,000,000. It embraces the course of the River Paraná between Rosario and Santa Fé over an extension of 160 kilometres. They have been compiled from the surveys in the same manner as those of the Lower Paraná. The list of all the maps contained in this portfolio is given in the Appendix.

4. Portfolio of Maps the Middle Paraná.

On this plan are shown all the constructive data which have relation to the works designed for the Port of the town of Rosario, which work is now in execution. The centre part of the plan shows the general plan, the works for the correction of the river, dredging and quay walls and wharings, sheds, warehouses, etc., and round it are artistically grouped plans and sections of the more important works as masonry and timber quay walls, concrete walls, and drawings representing the type of the dredging plant used.

5. Wall Plan of the Port of Rosario.

The photographs contained in this album show the most important points of the river and also the works which have been carried out. A detailed index of all the photos is given at the end of this booklet.

6. Album with photos of the River Paraná.

III. RIVER URUGUAY

The port of Concepción del Uruguay, situated at a distance of 184 kilometres from the mouth of this river, is the last port that can be reached by ocean-going vessels. Besides having a basin for the coasting vessels in the smaller arm of the river, access to which is given by an artificial access channel with its entrance protected by a stone dam, there exists also in the principal arm of the river a great mole for the ocean-going vessels.

1. Plan in relief of the port of Concepción del Uruguay. Scale 1:5000.

The plan shows these installations and the peculiarities of the river bed at this point.

At Concepción del Uruguay is installed the Commission

for the Study of the River Uruguay under the direction of the Direction General of Hydraulic Works.

2. Portfolio of
Maps of the Ri-
ver Uruguay.

The 21 maps which this portfolio contains are of an exploration of the Upper River Uruguay (from Concordia to Santo Tomé), of the survey of the Middle Uruguay (from Concordia to Concepción), and of the survey of the Lower Uruguay from Concepción to its mouth.

Besides these maps there are others with details of the parts that are difficult to navigate; they are drawn to a scale of 1:10.000 and show the improvements and the buoys that has been projected or executed.

A detailed list of these maps is given at the end of the booklet.

3. Portfolio of
the Plans show-
ing the studies
of the River Uru-
guay.

This portfolio contains 15 sheets showing the most important hydraulic features of the River Uruguay, such as instantaneous sections, studies of the tides and slopes, graphic demonstrations of hydrometric observations, and studies of the flow of water and velocities at different places, etc.

In the corresponding Appendix details of these plans are given.

4. Descriptive Me-
moir.

For the benefit of all who take an interest in the studies, surveys and works that have been carried out in the River Uruguay, a descriptive memoir has been prepared, which deals with the studies and projects for the improvement of this river.

5. Album with Pho-
tographs

This album, like those above mentioned, contains views of the different points of the river, of the works, dredgers, steamers and other craft at the disposal of the Commission, signal for navigation, etc. Details of these photos will be found in the last appendix of this booklet.

IV. — THE MILITARY PORT OF BAHIA BLANCA

1. Plan of the Es-
tuary of Bahia
Blanca.

This plan shows the topography and hidrography of the estuary of Bahia Blanca, and the relative position of the Military Port, located in Punta Alta; of the commercial Port belonging to the Ferro Carril del Sud (Southern R.R.) located near the Arroyo Napostá; of the commercial Port of the Ferro Carril Bahia Blanca y Nor-Oeste (Bahia Blanca

and North Western Railway) located near the Arroyo Galvan. More inside of the estuary there is another pier for the chilled beef factory at Cuatrerros.

This plan shows with blue colour — of deepen hue in proportion with the depth of the water — that in the estuary there are not less than 32' of water for all its length from the Atlantic up to Punta Alta in here is located the Military Port: and that in the anchorage of « Puerto Belgrano » opposite the Military Port, can ride safely at anchor the largest fleet.

From the anchorage there is a channel about 2000 m. in length, dredged (for the present) to 21 feet at low tide and 32 feet at high ordinary tide, which allows the largest men of war to pass from the anchorage to the tidal basin of the Military Port. There is also another channel dredged to 18' at low tide and 29' feet at high tide which allows commercial ships to follow the estuary up to the commercial Port of the Southern Railway opposite Bahia Blanca.

This plan contains all the works in project — even those for a far away future — and the works that at present are sufficient for the Argentine Navy.

2. Plan of the Naval Station.

These works — in their majority already finished — consist of:

- a) An outer harbour which protects the tidal basin from the waves of the estuary.
- b) Of a tidal basin for large men of war, dredged to 30 feet at low tide and with 41 feet at ordinary high water.
- c) Of a granite dry dock, — the largest of America — in which any ship of war or merchant can be docked — the « Baltic » can enter this drydock and the « Iowa » was docked here.
- d) Of a quay wall 250 m. long and 30 feet deep at low water, provided with hydraulic cranes, one of which of 30 tons power.

This quay wall is not yet finished but will be by the middle of 1904.

Round the tidal basin there are workshops for the repairs to ships, deposits for armaments, etc. There are also

houses for employees, barracks, and is also ready the first section of the Naval Hospital with 80 beds and in position of receiving 400 in case of war.

The Naval Station is provided with waterworks, sewerage, electric light, and usual installations for the service of a dockyard.

Also a small town has almost sprung up round the dockyard in here in 1898 there was a complete desert.

3. Plans of the graving Dock and annexed tidal Basin.

This plan shows the principal dimensions and details of the dry dock, 222 m. long, 27 m. wide at the entrance and 10 m. deep on the sill, at ordinary high tides.

This plan shows the system of construction of the dry dock, built entirely of concrete made of portland cement, sand and gravel, with a facing of granite so that the general aspect of the dry dock is as if it were built entirely of granite. Thus it combines the durability of granite with a moderate expense and rapidity of construction.

The dry dock can be pumped out in 2 1/2 hours by means of two large centrifugal pumps, driven each one by a 400 H.P. compound engine; the dock is also provided with hydraulic capstans and cranes, electric light, water mains, railway service, etc. The entrance is closed by a sliding caisson removed by hydraulic power in 3 minutes. There is also an intermediate floating caisson for the internal divisions or for the purpose of leaving dry the sliding caisson when this needs painting.

4. Normal sections of the principal works.

This plan shows the general outlines and dimensions of the most important works, that is:

- a) Entrance channel, dredged with 80 m. width at the bottom, and depth of 32' at O. H. W. and 21' at O. L. W.
- b) Pumping-engine house and sliding caisson with its recess.
- c) Diagram showing the dimensions of the largest vessels afloat in comparison with the dimensions of the graving dock.
- d) System of construction of the graving dock, in its various periods.
- e) Details of the sliding caisson at the entrance of the dry dock.

This plan shows the arrangement of the quay wall annexed to the graving dock, the normal section of this quay wall, and the arrangements of its various parts, that is :

- a) Hydraulic movable cranes of the elevated type, with its adjoining sheds for temporary deposit of goods, armaments, etc., to be transhipped.
- b) 30 tons — hydraulic crane with derricking jib, with railing sidings for handling large guns or bulky weights.
- c) Coal elevators for unloading about 100 tons of coal per hour from the colliers to on land, or for deposits, loading 120 tons of coal per hour to the war vessels, or to barges, or railway trucks, including screening and weighing.

5. Quay Wall.

These albums contain a collection of the most important plans of the Naval Station, Lighthouses, Semaphores, and other works. The collection consists of 120 sheets of 0.65×1.20 mts., showing general plans, studies, entrance channel, graving dock, engine house and engines, sliding caissons, hydraulic pressure mains, cranes, tidal basin, quay wall, water supply, building for the storage tank, sewers, building, and various other designs.

6. Two albums with different details of the Works.

All these plans are mentioned in detail in the last Appendix.

This album consists of a collection of 62 views of the Military Port, all of which are detailed in the appendix to this booklet, and which show the state of the works, and how they are used for war vessels.

8. Photograph Album.

V. MASONRY DAM AND RESERVOIR

For the Irrigation Works of the Province of Tucumán

The Department of Public Works & Irrigation of the Province of Tucumán has designed a great natural storage reservoir of a capacity of 200,000,000 cubic metres of water, destined for the irrigation works of this province. The cost of this work has been estimated at over one million of Ar-

I. Plan in relief of the Masonry Wall and Deposit of Cadilal.

gentine currency. The plan shows the general disposition of the works and the artificial lake.

The author of the design is the Director of the Department of Public Works of the Province, Mr. Charles Wauters, Civil Engineer.

Plan in relief showing the disposition of the retaining wall of the Reservoir of Cadillac.

This plan shows on a larger scale than the former one, the disposition of the works of the retaining wall, intake overflow, etc.

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Of the plans, maps & photographs contained in the different portfolios & albums

1º — River Paraná

This contains the following photos of the Port of Buenos Aires : Photograph Album.

1. General view of the Workshops of the Ministry of Public Works in April 1899.
2. Ditto. ditto. in October 1903.
3. Ditto. ditto. with a view of the Entrance Channel, 1903.
4. Ditto. ditto. from the signal of the South Channel, 1902.
5. Ditto. ditto. in December 1902.
6. Slip belonging to the Ministry of Public Works in July 1899.
7. Ditto. ditto. in January 1900.
8. Ditto. ditto. (two views) in 1900.
9. Workshops and protecting moles of the South Entrance Channel.
10. Workshops of the Ministry and Offices of the Direction.
11. Framework of the original Workshops, 1897.
12. Compound Engine of the Workshops, July, 1899.
13. Turning and fitting shops, August 1903.
14. Ditto. ditto.
15. Small lathes and planing engine, 1898.
16. Dynamos for light and power, September 1903.
17. Large Compound Engine of the Workshops.
18. Small ditto. ditto.

19. Carpenter's shop, August 1903.
20. Ditto. December 1902.
21. Bandsaw constructed in the Workshops, 1901.
22. Punching & Cutting Engine and planing engine for wood.
23. Big lathe, 1900.
24. Small steam hammer, 1900.
25. Smith's shop, 1903.
26. Boilermaker's Shop, 1902.
27. Ditto 1903.
28. Smith's Shop, 1902.
29. Foundry, 1902.
30. Ditto. with cupola, 1902.
31. Gasworks with gas buoys ready to be erected.
32. Ditto. South front.
33. Ditto. Accumulators, water-tank, and gasometer.
34. Luminous buoys.
35. Gasworks. Wharfing and cranes for handling the buoys.
36. Luminous buoys.
37. Gasworks — Compressors.
38. Ditto. — Boilers.
39. Ditto. — Purifiers.
40. Ditto. — Furnaces.
41. Water-tank and filter.
42. Semaphore and house of the 2nd. Chief.
43. Refouleur (Mud pump).
44. Low grounds in the port works being filled by the refouleur.
45. The dredged material filling the low grounds.
46. Low grounds after having been filled.
47. Entrance of the South Channel — Protecting mole.
48. Ditto. ditto. ditto.
- 49 & 50. Views of the protecting mole.
51. Entrance mole of the Port.
52. Reconstruction of the Riachuelo wharfing.
53. Ditto. ditto. ditto.
54. Ditto. and Riachuelo Port.
55. Ditto.
56. Riachuelo port.

- 57. } Ditto.
- 58. }
- 59. View of the Avant-Port.
- 60. Ditto.
- 61. Dock Sud (South Dock).
- 62. }
- 63. } Ditto.
- 64. Avant-port and Riachuelo.
- 65. Ditto.
- 66. Slipways of the Ministry of Public Works.
- 67 & 68. Dock No. 3.
- 69 & 70. Grain Elevators.
- 71. Hydrographic Office at the North Basin.
- 72. Graving Dock.
- 73. Bridge over the Riachuelo.
- 74. Engine House.
- 75 & 76. Vessels undergoing repairs.
- 77. Birdseye view of the Workshops of the Port of Buenos Aires.
- 78. Outer mole of the South Dock.
- 79. Entrance to the Moles of La Plata.
- 80. Central Dock (La Plata).
- 81. Ditto. ditto.
- 82. Naval Station at La Plata.

Photos of Vessels
and other Craft.

- 1. Barge for the transport of materials.
- 2. Ditto. Floating pile driver.
- 3. Floating shearlegs and barge for the transport of dredged material.
- 4. Barge with piledriver, and ditto. for the dredged material.
- 5. }
- 6. } Barges for the transport of dredged material.
- 7. }
- 8. } Houseboats for surveying purposes.
- 9. Houseboat and Floating Semaphore.
- 10. Floating Semaphore.
- 11. }
- 12. } Ditto. ditto. and steam launch for a surveying party.

- 13. Ditto.
- 14 & 15. }
 - 16. } Steam launch for surveying purposes.
 - 17. }
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- 19. } Steam launch for surveying purposes.
- 20. }
- 21. } Steamers for surveying purposes.
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- 32. Barge, dwellinghouse and office for surveying purposes.
- 33 & 34. }
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 - 44. } Dredgers.
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- 48. Dredger and Refouleur (Mud-pump).
- 49. Excavater and Refouleur.
- 50. Barge with boring apparatus and ditto. with steam pump.
- 51. Floating crane and Refouleur (Mud-pump).
- 52. Dredger.

1° — River Paraná

LOWER PARANÁ. — Index sheet and sheets 1 to 15.

Index sheets showing the division of maps from Rosario to the mouth of the Guazú.

Portfolio with
Maps.

1. City of Rosario and neighbourhood.
2. Alvear and Paraguayo Bars.
3. Villa Constitución and neighbourhood.
4. San Nicolás and neighbourhood.
5. Tonelero and Las Hermanas Bars.
6. Obligado and neighbourhood.
7. San Pedro and neighbourhood.
8. From San Pedro to the Isla Grande (Great Island).
9. Mouth of the Paraná de las Palmas and neighbourhood.
10. Island of the Bizcaino, Ibicuy River, Zanja Mercadal and upper mouth of the Talavera.
11. Island of the Botija and lower mouth of the Talavera.
12. From Dorado Island to «El Ceibo».
13. Portuguese Bar and neighbourhood.
14. River Bravo and its mouth.
15. Mouth of the Guazú and of the Bravo.

MIDDLE PARANÁ. — Index sheet and sheets 1 to 8.

1. City of Paraná and neighbourhood.
2. City of Santa Fé, river of the same name, and part of the River Paraná as far as the Tragadero Bar.
3. From the Paracao Bar to the Araña Islands.
4. From the Araña Island to the Tacuani.
5. From the Tacuani to the Reyes.
6. From the mouth of the Reyes to the Island of Los Pajaros.
7. From the Island of Los Pajaros to the mouth of the Bobo.
8. From San Martín to Alberdi.

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Photograph Album

Page	1.	Port of Zárate.
»	2.	Rosario, View of the town and the national wharfing.
»	3 & 4	Rosario, Anchorage.
»	5.	Dredging plant at the Paracao Bar.
»	6.	Sparbuoys at the Paciencia Bar, Buoys and guidance signals at the Paracao Bar.
»	7.	Bajada Grande. General view of the wharfing.
»	8.	Paraná — Salto del Calderón.
»	9.	Paraná — Anchorage.
»	10.	Puerto Viejo (Old port).
»	11.	Paraná — Birdseye view from the Morro.
»	12.	Paraná — Limekiln and Panorama.
»	13.	Santa Fé — Views of the town and wharfing.
»	14.	Santa Fé — Installations of the surveying commission and the cut of the Paraguayo.
»	15.	Colastiné — Port and deposit of hardwood logs.
»	16.	Colastiné — View of the port.
»	17.	Mouth of the Piragua and Slaughterhouse Santa Elena.
»	18.	La Paz (Curtiembre) — View of Esquina.
»	19.	View of Esquina.
»	20.	Port of Reconquista — Wharfing at Goya.
»	21.	Bella Vista.
»	22.	San Antonio. Pilcomayo.
»	23.	Port of Asunción (Capital of the Republic of Paraguay).
»	24.	Anchorage.
»	25.	Corrientes, view of the Mole and Government House.
»	26.	Views of the town of Corrientes.
»	27.	Island of rocks below Itatí.
»	28.	Views of Itatí.
»	29.	Church of Itatí, Group of Palmas indians.
»	30.	Views of Humaitá and neighbourhood.
»	31.	Humaitá.
»	32.	Villa Pilar. Island de Aquino.
»	33.	Views of Formosa.
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Page	35. & 36.	Views of Formosa.
»	37.	Guardia Angostura near Villeta. Villeta.
»	38.	Lambaré Hill — Empedrado.
»	39.	Colonia Urquiza. — (La Curtiembre) (Tannery).
»	40.	Zanja Mercadal.

2° -- River Uruguay

The 23 maps it contains are in detail the following:

Portfolio of Maps.

- Sheet 1. Exploration of the Upper Uruguay from Concordia to Santo Tomé.
- Sheets 2, 3 & 4. General maps of the Middle Uruguay showing in conjunction the peculiarities of the river bed and the relative position of the principal points.
- Sheets 5, 6 & 7. Maps of the lower course of the river, giving a topography entirely different to the other parts.
- Sheets A & A'. Detail plans of the bars of Corralito and Yuquerí, which are situated immediately below the port of Concordia. The first of these bars is full of rocks.
- Sheet B. Map of the Vuelta (curve) of Dayman; this part of the river is very regular and easy to navigate.
- Sheets C & C'. Hervidero Bar. This is a tortuous passage between rocks. Its rectification to a depth of 9 feet has been projected.
- Sheet D Chapicuy Bar; the most difficult bar, and the one which is the greatest obstacle to the access to the port of Concordia; it has been surveyed with great care in order to design its canalization.
- Sheets E. F. & G. H. & I. Maps of the Bars of Guaviyú, Sombrerito, San José, Cancha Seca, and Pepe Ají; these bars are formed by sand and gravel.
- Sheet J. Peruchoverne Bar, the last of the many which exist between Concordia and Colón.

Sheet K. San Francisco Bar. This bar was deepened to 9 feet over a width of 100 metres in order to facilitate the access to the Port of Colón.

Sheet L. Plan of the Port of Paysandú, which town is situated in the Republic of Uruguay. Though there is plenty of depth in the port itself, its access is made difficult by the existence of the Almiron Bar, 9 kilometers down river.

Sheet M. Almiron Bar with a minimum depth of 10 feet. The execution of the works for improving this bar is left to the Uruguayan Government.

Sheet N. Map of the anchorage and port of Concepción del Uruguay.

Portfolio with
Plans of the Studies.

Sheet 1. Instantaneous sections of the tidal wave, which show the manner in which the surface of the River Uruguay is affected by the tides of the Atlantic Ocean, which are transmitted over a distance of 293 kilometers from the mouth of the river during the periods of a low river.

Sheet 2. Graphic demonstration of the tidal wave, showing the form of the wave for an ordinary and an extraordinary tide.

Sheet 3. Longitudinal section of the surface of the river Uruguay below Concordia, showing the slopes of the river at its different heights of water.

Sheet 4. Graphic demonstration of the relation of the zeros of the water-gauge, which have been levelled by studying the tides as there was no precise leveling, which is now being carried out.

Sheets 5 to 9. Graphic demonstration of the observations at the gauges at Nueva Palmira, Fray Bentos, Concepción del Uruguay, Nueva Escocia, Concordia, and Paso de los Libres.

Sheets 10 & 11. Diagrams of the winds and rainfall registered during the years 1900 and 1901 at Concepción del Uruguay.

Sheet 13. Diagram representing the variation of the flow and velocity for the different states of the river at Concepción del Uruguay and Nueva Escocia, as

well as the corresponding different heights of water at Concepción del Uruguay and Concordia.

Sheets 14 & 15. Sections of velocities at Concepción del Uruguay and Nueva Escocia for different heights of water and conditions of currents.

Pages 1 & 2. Types of the signals indicating the centre of the dredged channel in the bars Banco Grande and Altos y Bajos. They carry lights during the night and a gauge which indicates the minimum depth in the dredged channel. Photograph Album

- » 3 & 4. Views of the mole for ocean traffic at Concepción del Uruguay when the river is very high.
- » 5. The mole of Concepción del Uruguay as seen from up river.
- » 6, 7 & 8. Vessels being worked at the mole of Concepción del Uruguay.
- » 9. Access from the shore to the mole of Concepción del Uruguay, showing the hut for the automatic tide-gauge on the right hand side, and that of the watchman on the left.
- » 10. The same access at a high flood.
- » 11 & 12. The bridge giving access to the mole during a high flood.
- » 13. Upper part of the bridge giving access to the mole, with Custom House and «Sub Prefectura» (harbour police).
- » 14. Entrance to the access channel for the inner Port for coasting vessels at Concepción del Uruguay.
- » 15 & 16. Views of the above-mentioned entrance channel.
- » 17 & 18. Dredgers for the excavation of the entrance channel.
- » 19 & 20. Dredgers operating in the inner port for coasting vessels of Concepción del Uruguay.
- » 21 & 22. Slip of the Ministry of Public Works at Concepción del Uruguay.
- » 23 & 24. Works for improving and extending the slipways at Concepción del Uruguay.
- » 25. Dredgers working in the River Uruguay.

Page 26. Bivouac of engineers on a survey.

- » 27. Offices of the Commission for Surveys and Works of the River Uruguay, at Concepción del Uruguay.
- » 28. Workshops of the Ministry of Public Works at Concepción del Uruguay.
- » 29. View of the port of Colón in its presents state.
- » 30. View of the port of Concordia in its present state.
- » 31. View of the port of Concordia, with a high river.
- » 32. View of one of the numerous rapids of the River Uruguay.

4° — MILITARY PORT AT BAHIA BLANCA

General Plans & Various Studies

1. General plan of the works for the defense of the Atlantic coast of the Argentine Republic. Scale 1: 2.500.000.
2. Hydrographic plan of the Port of Belgrano at Bahía Blanca (general plan of the works) Scale 1: 150.000.
3. Hydrographic plan of Puerto Belgrano and soundings. Scale 1: 40.000.
4. Hydrographic plan of Puerto Belgrano. Pits and borings. Scale 1: 40.000.
5. Hydrographic plan of Puerto Belgrano. Scale 1: 40.000.
6. Topographic-hydrographic-geognostic-an hidrognostic plan of the neighbourhood of Punta Alta at Puerto Belgrano. Scale 1: 5000.
7. Cross sections A. B' (with reference to the plan mentioned above)
8. Ditto. A. B' (Ditto. Ditto.)
9. Ditto. C. C' (Ditto. Ditto.)
10. Longitudinal sections
 X. Y. (Ditto. Ditto.)
11. Ditto. W. S. (Ditto. Ditto.)
12. Hidrognostic studies in the neighbourhood of Puerto Belgrano (sections).
13. Sources of studies for the Entrance Channel.
14. Plan of the Naval Arsenal reduced to the works necessary for the immediate future. Scale 1: 2500.

15. Plan of the Naval Station which will in the future be transformed into a Naval Arsenal, (most urgent works), Scale 1 : 2500.
15. General constructive plan of the Naval Station Scale 1 : 2500.
17. General plan of the Naval Station. Scale 1 : 2000.

ENTRANCE CHANNEL

18. General plan of the soundings in the entrance channel and the Avant-Port. Scale 1 : 2000.
19. Various buoys for mooring and other purposes.
20. Beacon.

GRAVING DOCK

21. Graving Dock-Plan and Sections. Scale 1 : 200.
22. Ditto. Disposition of the layers of concrete in the bottom and side walls. Scale 1 : 50.

Engine House & Engines

23. Frontage towards the Avant-Port. Scale 1 : 50.
24. Frontage and sides of the Boiler House. Scale 1 : 50.
25. Plan and sections of the walls. Scale 1 : 50.
26. Plan showing the installation of the centrifugal pumps. Scale 1 : 100.
27. Details of the installation of the main-and leakage pumps. Scale 2 : 20.
28. Details of the engines of the main pumps. Scale 1 : 10.
29. Details of the centrifugal pumps. Scale 1 : 10.
30. Details of the sluices of the drainage culvert. Scale. 1 : 10.
31. Details of the boilers. Scale 1 : 10.
32. Accumulator tower. Scale 1 : 20.
33. Plan showing the complete arrangement of the hydraulic machinery and accumulator. Scale 1 : 20.
34. Details of the hydraulic pressure machinery.
35. Details of the accumulator.

Sliding Caisson

- 36. Sliding caisson with lifting bridge and hydraulic action, with corresponding diagram (general plan).
 - 37. Sliding Caisson — Plans and section (working drawings).
 - 38. Sliding Caisson—Longitudinal section and cross sections.
 - 39. Sliding Caisson—Hydraulic machinery for working same.
 - 40. Floating Caisson—(general plan).
 - 41. Ditto. —Longitudinal- and end views.
 - 42. Ditto. —Longitudinal- and cross sections.
 - 43. Ditto. —Various plans.
- (Sheets 41, 42 & 43 are working drawings)

Hydraulic Piping, Cranes, etc.

- 44. Arrangement of the cranes, hydraulic piping, roads, etc., belonging to the quay wall.
- 45. General plan of the pressure- and return mains, and the water supply for the graving dock.
- 46. Fixed crane of 30 tons.
- 47. Moveable crane of 5 tons.
- 48. Ditto. of $1\frac{1}{2}$ tons.
- 49. Hydraulic capstan of 5 and 10 tons.
- 50. Ditto. ditto. of 1 tons.

Tidal Basin

- 51. State of the dredging on 31st. August 1903. Scale 1 : 1000.
- 52. Details of the slopes, ladders, mooring posts, buoys, etc.

Quay Wall

- 54. Construction of the cofferdam made for the purpose of building the quay wall in the dry.
- 55. Plans, elevations, and sections.

56. Ashlar, bollards mooring posts, rings, etc.
57. Piping, posts, bollards, and other metallic accessories.
58. Normal- and other sections of the quay wall.
59. Subway for the service pipes.
60. Discharge pipes for the sewers.
61. Plan of ensemble of the quay wall with cranes, elevators for coal, etc.

**Derivation of the Water Supply from the River
« Sauce Grande »**

62. Catastral plan of Bahía Blanca, scale 1 : 200,000.
63. General plans and longitudinal sections.
64. General plan of the piping (1st. section).
65. Ditto ditto (2nd. section).
66. Ditto ditto (3rd. section).
67. Ditto ditto (4th. section).
68. Longitudinal section of the ramification to Puerto Militar and to the village Puerto Belgrano.
69. Longitudinal section from the origin to the town of Bahía Blanca.

Deposit and Sources of the Water service

70. Elevation and plan of the tank for the water service, telephone station, etc., scale 1 : 50.
71. Details of the construction of the watchtower, scale 1 : 20.
72. Intake culvert for the water service, and other works, such as pits in the district of the Military Port, scale 1 : 5000.
73. Sources of the water in the downs of the Magnetic Observatory.
74. Distributing pipes for the water service in the various districts of the Military Port.
75. Engine house for the water service.

Sewers

76. Plan and section, scale 1 : 100.
77. Various sections and registering outlet (1 : 20).
78. Regulating chamber, scale 1 : 20.
79. Details of the regulating chamber and discharge chamber.
80. Detail of the outlet into the sea, scale 1 : 20.
81. Plans and sections.
82. Details of the regulating chamber.
83. Details of the registering outlet, etc.
(Sheets 69, 70 & 71 show how the sewers were constructed and contain the modifications that were introduced during construction.

Various Buildings

84. Hospital for the Navy. Plan of a pavillion.
85. Ditto Kitchen, Wash-house, and other out-
(houses.
86. Ditto Ditto Ditto.
87. Ditto Cellar of the out-house to pavillion N° 3.
88. Hospital — Sidewall (masonry works).
89. Dwellinghouse for the Medical Director of the Hospital.
90. Chalet N° 8.
91. Chalet N° 8 bis.
92. Offices, and other buildings.
93. Dwelling-house N° 23 for employees.
94. Ditto N° 24 Ditto.
95. Post and Telegraph office. Elevation and sections.
96. Ditto Ditto Plans and details.
97. Principal entrance to the Naval Arsenal.
98. School «Humberto I», erected by public subscription.
99. Magnetic office of the Military Port.
100. Cemetery, crematorium, etc.
101. Barracks for the *Coast Artillery* — General plan.
102. Ditto Ditto Elevation and sections.
103. Powder House — elevation, plan and sections.
104. Ditto details of walls and windows.

- 105. Powder House — various details.
- 106. Ammunition stores.
- 107. Dwellinghouses for the officials of the powder house and ammunition stores.

VARIOUS DESIGNS

- 108. Moorings for ocean-going vessels in the River Santa Cruz (transformable into graving dock).
- 109. Naval Station in the River Santa Cruz.
- 110. Telegraph line to the South Coast (1st. section).
- 111. Ditto. Ditto. (2nd. section).
- 112. Ditto. Ditto. (3rd. section).
- 113. Ditto. Ditto. (4th. section).
- 114. } Strategic Railway — Temporary bridge.
- 115. }
- 116. General plan of lighthouses and semaphores, to be erected along the Atlantic Coast.
- 117. Lighthouses and semaphores at the entrance of Bahía Blanca.
- 118. Lighthouse at Cape de las Vírgenes.
- 119. Metallic tower for lighthouses.

Photographs

A Collection of 62

(Dimensions: 30×45 cm. = $12'' \times 18''$)

- 1. Strand of Punta Alta — before the commencement of the works.
- 2. Building for the waterworks — watch tower.
- 3. Ditto. Ditto. Ditto.
- 4. Construction of the concrete platform of the Graving dock.
- 5. Granite facing up to the first altar.
- 6. Ditto. Ditto.
- 7. Southern entrance to the dock — during the construction.
- 8. Southern entrance to the Graving dock and engine house.

9. Erection of the keelblocks and bilge blocks.
10. Erecting the intermediate caisson.
11. Southern entrance at the moment of letting the water in.
12. Northern entrance and view of the works.
13. Taking the floating caisson out and working the sliding caisson.
14. Recess for the sliding caisson.
15. Basin in front of the graving dock.
16. Entrance basin to the graving docks during rough weather.
17. Waves against the sliding caisson.
18. Letting the water into the graving dock.
19. View of the dock taken as the «San Martín» was entering.
20. The first battleship entering the graving dock.
21. The «San Martín» breaking the garland.
22. The entrance open after the battleship had entered.
23. Ditto. closed Ditto. Ditto.
24. Floating caisson, which closes up the 3rd. section.
25. Battleship in the dry-stern view.
26. General view of the docks and Engine house.
27. General view of the dock after a battleship has left it.
28. Temporary mole at the entrance of the graving dock.
29. Tugs in the graving dock.
30. The english cruiser «Cambrian» entering the dock.
31. The U. U. S. battleship «Iowa» entering the dock.
32. The battleship «Iowa» in dock, seen from the Northern entrance.
33. The battleship «Iowa» in dock, seen from the Southern entrance.
34. The battleship «Iowa» in dock, after the water had been pumped out.
35. Strutting the battleship «Iowa» in the graving dock.
36. Stern of the battleship «Iowa» and Southern entrance to the graving dock.
37. Engineer Villanueva (whom as Minister of War and Marine ordered the construction of the Military Port), at the bottom of the Graving Dock with Admiral Sumer of the U. U. S. S. battleship «Iowa».

38. The battleship «Iowa» dry in the dock.
 39. Stern of the battleship «Iowa» and Engine house.
 40. Cruiser «Newark» and yacht «Varuña» in the graving
(dock.
 41. Ditto. in the graving dock.
 42. Ditto. seen from the bow in the graving
(dock.
 43. Ditto. in the graving dock.
 44. The crew of the cruiser «Newark» drilling.
 45. Training ship «Sarmiento» and battleship «Puey-
rredón ».
 46. The training-ship «Sarmiento» in the graving dock.
 47. Quay wall. Erecting the granite facing.
 48. Quay wall in construction.
 49. Quay wall. Construction of the subway for the
piping.
 50. Quay wall in construction.
 51. Water Works Building, Watch-tower and Hospital.
 52. General View. Water works Building, Watch tower,
and Hospital.
 53. Watch tower, and 1st. Section of the Naval Hospital,
 54. Panoramic view — Watch tower, Naval Hospital,
Engine house, etc.
 55. A pavillion of the Naval Hospital.
 56. House for officials (June 1899).
 57. House for officials, 3 years after the plantations were
finished.
 58. School «Humberto I ».
 59. Railway bridge over the Arroyo Pareja (downstream).
 60. Ditto. Ditto. Ditto. (up stream).
 61. General view of the maritime works, and anchorage
of the fleet.
 62. Lighthouse at «Punta Mogotes ».
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